POWER

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Their Hearts Were in It

THE train stopped at a small New England town. There had been a deep snowstorm, and two men were clearing the paths and platform about the station.

On the Green across the road a half-dozen youngsters were building a snow fort.

It was amusing to see the difference in the spirit and zeal with which the two groups worked.

The boys shoveled and packed and shaped incessantly as though the foe were coming up the valley and the safety of the town depended upon the completion of that citadel before the enemy got within firing distance.

The hirelings, after each few shovelfuls, ran up against some kind of a diversion. One took off his glove or mitten and put it back on, perhaps for some not evident purpose. The other banged his shovel on the asphalt walk to free it of snow, watched the alighting passengers, banged it again, called his companions' attention to somebody or something in the crowd, and then listlessly shoveled a few more strokes.

And as the conductor hollered "Board!" and the train moved off, one was biting a chew off from the corner of a plug and the other leaning upon his shovel to shout a parting admonition to the brakeman.

The train rolled on past fence posts and roofs capped with white and hills clothed with snow-draped trees, and I wondered what the effect would be if all the workers in the vineyard went at their jobs with the zest and interest that was manifested by the boys.

The difference is, of course, that the boys' hearts were in their work. They labored with the vision of their completed fort in their minds and in the anticipation of the fun that they were to have attacking or defending it.

What does a shoveled path mean to a hired man, and what difference does it make to him if he does it well or poorly, in one hour or two?

Make him typical of all who work with their heads or with their hands and picture if you can what the effect would be if everybody realized that in doing his part of the world's work he is working for himself— not in the narrow sense of immediate wage or individual reputation, but of the progress and prosperity of the community, the nation, the world of which he is a part.

F. R. Low

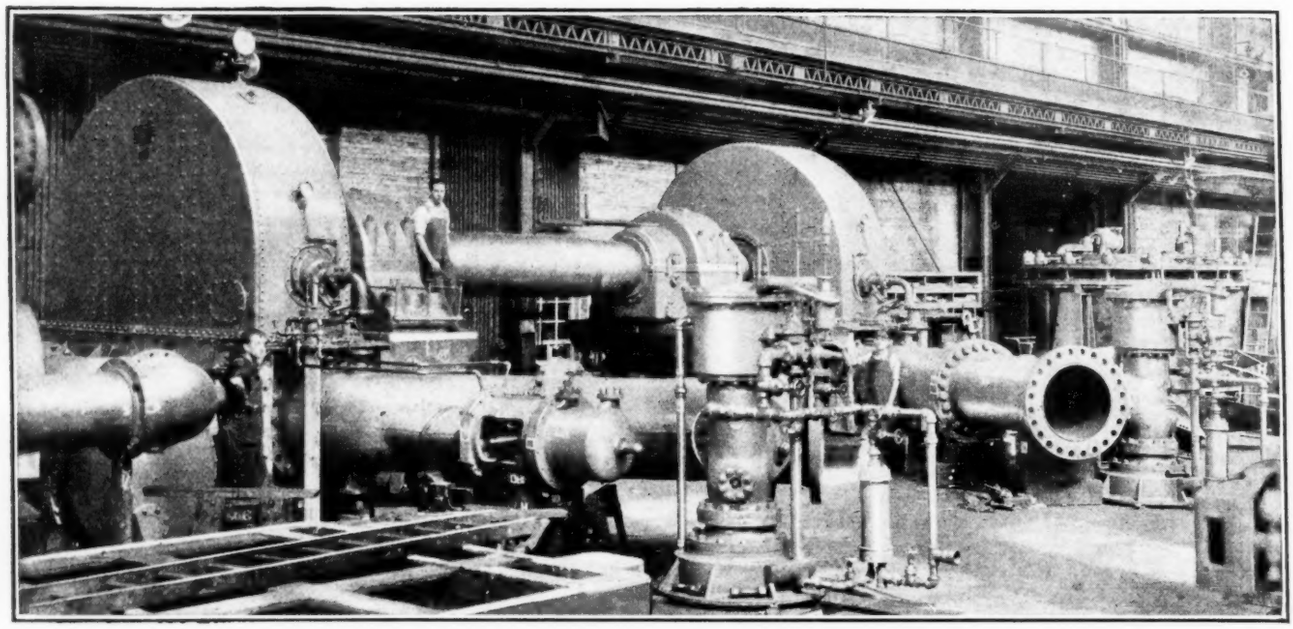


Fig. 1—Shop assembly of 40,000-hp., double overhung impulse-wheel unit, minus generator

Hydraulic Turbine To Operate Under Nearly One Half Mile Head

Largest Impulse-Wheel Unit Ready for Operation Under Highest Head so Far Utilized in the United States—Water-jet Over 7-in. in Diameter with a Velocity of 370 Ft. per Sec.—Governing of the Unit and Safety Devices Provided of Special Interest

THE San Joaquin Light & Power Corporation of Fresno, Calif., is completing the first stage of a 500,000-hp. hydro-electric development on the Kings River. This first stage, known as the Balch project, is about 56 miles from Fresno and 30 miles above the terminal of the Sante Fe Railroad at Piedra, Calif. Ultimately, it will consist of four 40,000-hp. units. The first unit is now being installed and is nearly ready for operation.

Designed for a static head of 2,381 ft., a net head of 2,243 ft. and a discharge of 180 cu.ft. per sec., the impulse wheel unit at 360 r.p.m. will develop 40,000 hp., but is capable of operating with a discharge of 200 sec.-ft., at which it will develop close to 44,000 hp. This is the highest head so far utilized in the United States and the largest impulse unit until the 56,000-hp. wheels for the Big Creek 2-A plant of the Southern California Edison Company are placed in operation.

In Fig. 2 is shown the power-house arrangement of this unit. The generator rotor, which is pressed onto the shaft, weighs approximately 206,000 lb. and its bore is 32 in. in diameter. The mainshaft rests in two bearings 22 in. in diameter and is flanged on both ends for directly bolting the wheel disk. Each wheel disk carries 20 cast-steel buckets which are secured to the disk by three individual steel bolts. The buckets are about 22 in. wide and, when bolted to the disk, form a bucket wheel of about 11 ft. over-all diameter.

Inlet and nozzle pipes leading the water to the wheel are below the floor. The inlet pipe is of cast steel, about 30 in. in diameter, with over 2 in. thickness of metal, and has been tested at the shops under a hydraulic pressure of 1,655 lb. per sq.in., to make sure that there were no flaws in the casting.

As will be seen in Figs. 1 and 2, each unit consists of two hydraulically independent wheels of the overhung horizontal-shaft type, one on each end of the generator shaft. Each wheel will develop 20,000 hp. resulting from a jet about 7¼ in. in diameter where it leaves the nozzle. This jet travels at a velocity of about 370 ft. per sec., or 250 miles per hour, driving the buckets at a speed of about 120 miles per hour and producing an impact force on each wheel of 61,000 lb., which must be taken up by the three bolts of each individual bucket when it passes through the jet. Considering also that 20 buckets pass through the jet 360 times per minute, one can obtain a picture of the severity of the hammer blow which this impact force exerts and the importance of properly dimensioning and locating the bolts on the buckets so as to avoid crystallization of the material which would result in failure of the bolt and serious accident at the plant.

This impact force of 61,000 lb., exerted on each wheel disk produces an additional load on the two generator bearings that carry the rotating parts, composed of the weight of the rotor of 206,000 lb., a shaft weight

of 54,000 lb., and the weight of both wheel disks with buckets of 60,000 lb., or a total of 320,000 lb. The bearings consist of babbitt shells resting in a ball-and-socket seat so as to adjust themselves according to the deflection of the shaft when subjected to the dead weight and the variable impact force due to load changes. These bearings, which are hollow castings, cooled by water, are provided with five oiling rings that pick up the oil from a basin and discharge it over the top of the shaft.

Since the parts in contact with the operating water pressure are subjected to a pressure of over 1,000 lb. per sq.in., the problem of grease lubrication required special study. A differential piston type grease compressor operated from the penstock pressure is used and

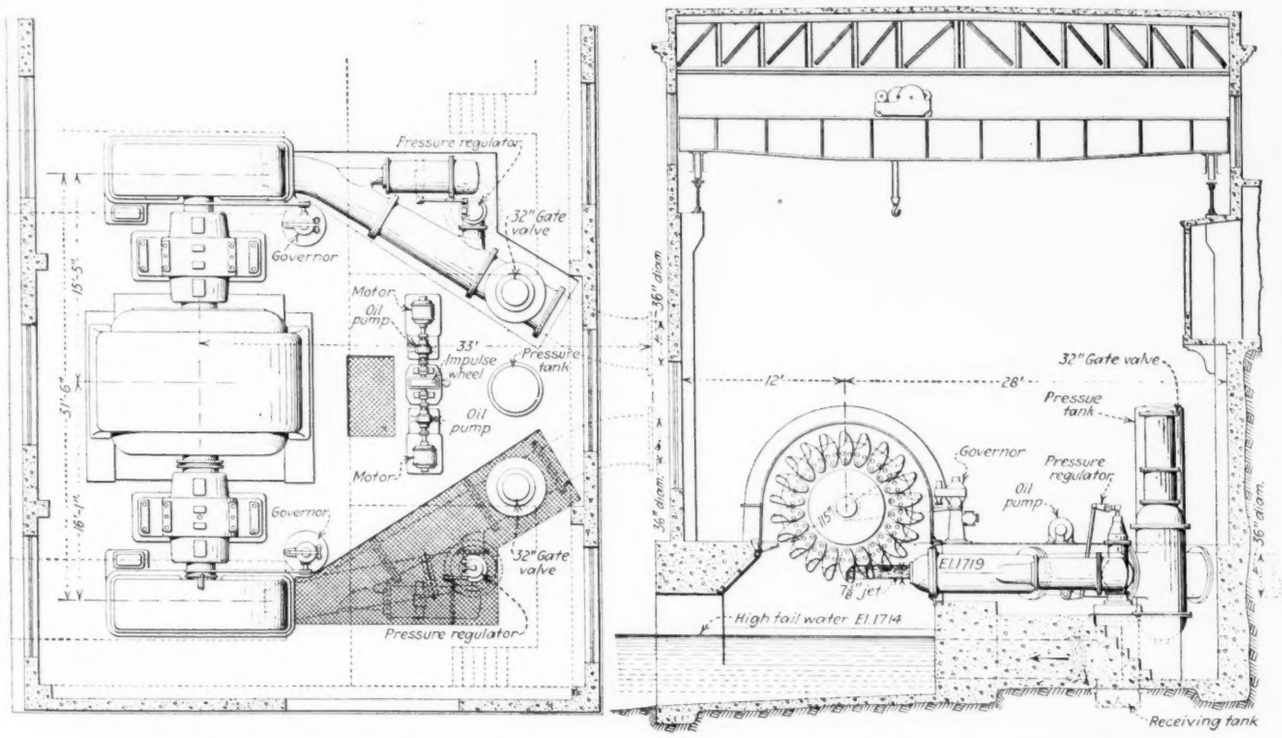


Fig. 2—Plan and elevation of power house showing general arrangement of unit

produces a pressure on the grease considerably in excess of that in the penstock, so that the lubricant is forced into the joints during operation against the existing penstock pressure.

It may be of interest to state that the flywheel effect of the rotating parts of such a unit is so great that when the water is shut off it would keep revolving for an hour or more. For the purpose of bringing the machine promptly to a stop, a hydraulic brake is provided on each wheel, consisting of a small hand-controlled nozzle that directs a jet against the back of the buckets, thus counteracting the rotation, so that the moving parts can be stopped in a few minutes.

The size of the jet producing the power on each wheel is varied by a needle that is directly operated from a servo-motor controlled by an oil-pressure actuator type of governor responding to the speed changes of the unit. Thus each wheel side is controlled independently, adding to the safety of the unit. This arrangement of using two governors for the same generating unit was first introduced by the maker of the equipment under discussion in connection with the impulse wheel units furnished for Big Creek plants Nos. 1 and 2 in 1913 and since has been adopted in many other plants, not only for impulse wheel units, but also for double Francis turbine units.

Each governor is mounted close to its respective wheel, the flyballs being belt driven directly from the main shaft. The flyball is of the balanced-spring precision type, completely encased and automatically lubricated. It transmits its motion to a floating lever which operates a double-acting hydraulically balanced pilot-type control valve, whose function is to distribute the pressure in the regulating cylinder containing the piston directly mounted on the rear end of the needle. The opposite end of the floating lever is connected to a relay and compensating dashpot that prevents hunting under varying load. The governor is equipped with a synchronizer for the purpose of starting the unit from the switchboard, for paralleling to the system, and for changing the load on the unit when paralleled to the system. For the purpose of quick action in case of accident, a so-called solenoid trip is provided on the governor, permitting the operator to press a button at the switchboard and, through the governor, immediately close the needle.

As the governors are capable of shutting off the water in a few seconds and this sudden stoppage of the flow in the pipe line would cause a destructive pressure rise, adequate precautions had to be taken. The penstocks are 4,882 ft. long and the average velocity of water is about 11 ft. per sec. when the unit develops its full load. Therefore, to protect the pipe line against serious pressure rises, bypasses have been provided, or so-called pressure regulators which are so connected to the governors that when the latter close the needles rapidly, the bypasses open synchronously and discharge

the water into the tailrace, so that no appreciable velocity change in the penstock occurs. The pressure regulators are provided with a dashpot arrangement, causing them to close slowly to reduce the wastage of water. This closing time can be adjusted through a bypass in the oil dashpot of the pressure regulator, or the dashpot can be locked so that the pressure regulator will act as a water wasting bypass, opening as the needle closes and closing synchronously as the needle is being opened.

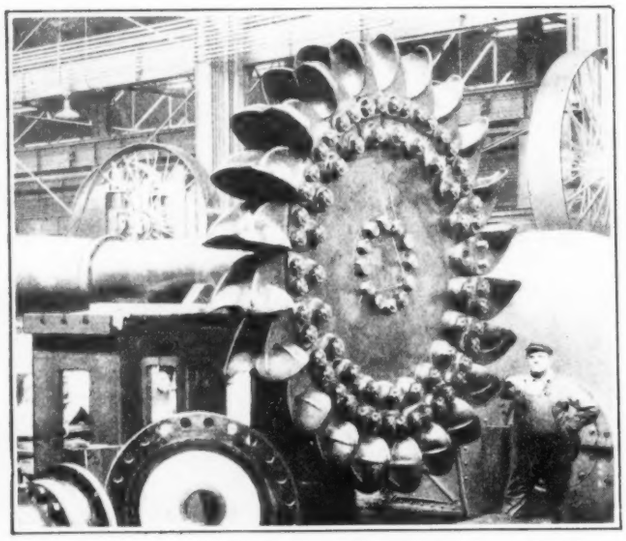


Fig. 3—One of the two impulse wheels

To prevent the needle controlling the jet from assuming rates of motion that may produce dangerous pressure rises, a feature has been introduced in the form of a rate-limiting device applied to each of the two governors. By means of this device the rate of motion of the needle in either closing or opening direction can be adjusted to any predetermined desired amount. During ordinary operation the pressure regulator will not open when the full load is thrown off gradually, but will open if the governor is called upon to close the needle faster than is permissible from the point of view of penstock conditions. In this way water-saving control is assured, and this is essential because the unit will draw water from storage. Guarantees have been given that the pressure rise in the pipe line will not exceed 8 per cent when the full load is thrown off the unit with the pressure regulator in operation and when both governors close their needles in 2½ sec. If for any reason the pressure regulator should be inactive, the pressure rise would amount to about 45 per cent of the normal operating head when both governors close their needles in 2½ sec. Without these protective devices the pressure rise will be in excess of 100 per cent above the normal head and would cause great damage to the pipe line.

As the pressure regulators previously described are governor actuated—that is, receive their motion from that of the needle controlling the jet impinging upon the wheel—they would not be responsive to other pressure rises caused in the pipe line. Should, for instance, some obstruction lodge in the throat from which the power jet issues, this would reduce the area of the throat and cause a sudden reduction in the flow of water, which, in turn, could produce a serious pressure rise in the penstock. Provisions have been made in the design so that the pressure regulators are responsive also to such pressure rises.

Reference to Fig. 6 will show that the pressure regulators consist of an elbow with a disk opening downward and forming the main bypass outlet. The disk is connected to a piston subjected to a pressure capable of holding the bypass in a closed position when the pressure regulator is not expected to act. Below the control piston the pressure is varied by a regulating valve operated from a floating lever, one end of which is connected to the main bypass and the opposite end to the piston of an oil dashpot, the cylinder of which receives its motion from the needle mechanism of the wheel. The dashpot is provided with an adjustable bypass in such a way that when the dashpot, by reason of the closing motion of the needle, is raised slowly, it will not cause the pressure regulator to open, but will open the regulator if the rate of closing of the needle by the governor is beyond the amount for which the dashpot bypass is set.

Supply pressure to the control valve is not obtained from the penstock pressure, but from an independent pressure source supplied by a tank located on the hillside above the power house and connected to the pressure regulator by individual piping. If for some reason the pressure in the penstock rises, it will cause an increased downward pressure upon the disk of the main bypass, so that at a certain overpressure in the penstock the downward force on the disk will overcome the resisting force on the balancing piston, and as a result the pressure regulator will open automatically like a pop valve. When the penstock pressure decreases again, the control mechanism of the regulator prevents closing at a rate faster than that conditioned by the setting of the bypass of the oil dashpot. In other words, when the pressure regulator opens automatically, it will close at the same rate as it does for the water-saving action described previously, caused by the motion of the governor.

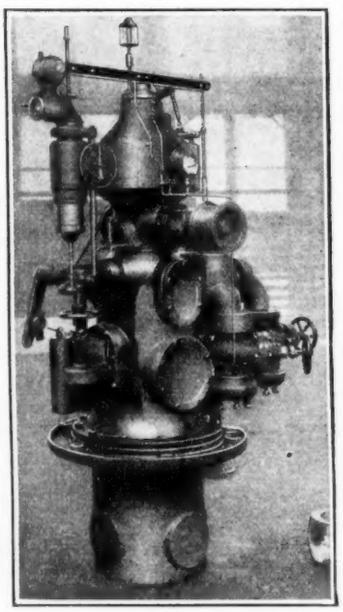


Fig. 4 — Semi-self-contained oil-pressure turbine governor

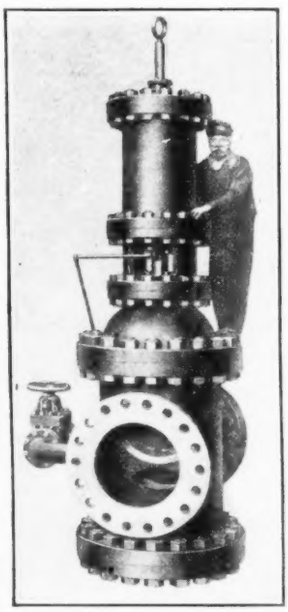


Fig. 5—Hydraulically operated gate valve used at plant

It is evident that the water discharging from the pressure regulators at the high operating pressure would have a destructive effect upon the tailrace. To eliminate this difficulty, special energy absorbers have been designed on the following principle: The water discharging from the regulator impinges upon a cast-iron bowl of the shape of a rotating Greek Omega, that is, having a center cone and a bowl-type outer periphery

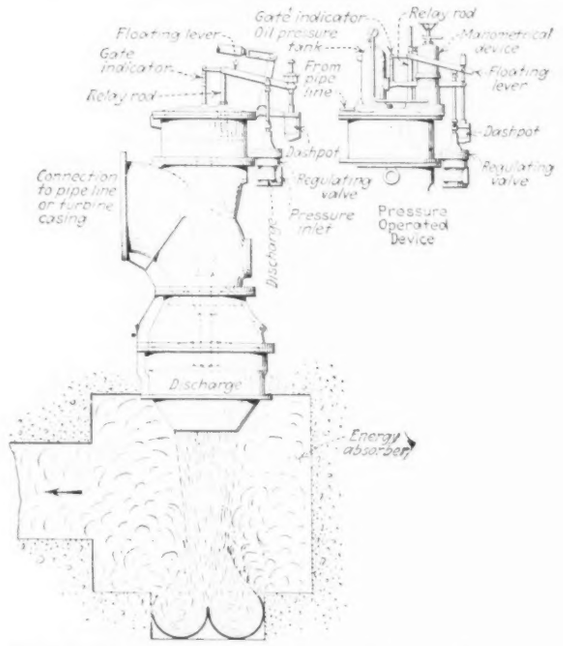


Fig. 6—Pressure-operated regulator and energy absorber for bypassed water

that directs the water radially outward and centrally upward toward the arriving water jet, and thus annihilates the energy of the impact, as indicated in the lower part of Fig. 6. The bowl is placed into a rigid plate-steel tee, grouted into the concrete and having a horizontal outlet from which the pressure regulator water discharges quite tamely into the wheel pit, and no wheel-pit liners are necessary below the high-water level in the tailrace.

Another feature is the use of a load-limiting device. When a unit is connected with a large system that must carry a certain amount of load as dictated by the load dispatcher, it is sometimes desired that this load be carried constantly, irrespective of drop in frequency of the power system, in which case the governor of the unit would increase the needle opening. The load-limiting device makes it possible to carry a constant load and also permits limiting the maximum load of the unit in accordance with the amount of water available at times and which, in this particular case during the dry season without storage capacity, is considerably less than the full amount that the unit is capable of consuming. The device, however, does not prevent the governor from closing the needle should the frequency rise above normal.

How the two governors of the unit receive the oil pressure for their operation from a central system is of interest. The primary elements of this system are two rotary helical gear-type pumps, equipped for dual drive, as indicated in Fig. 7. The outer ends of the pumps are directly coupled to 60-cycle three-phase induction motors, and the inner ends can be alternately clutch-connected to a small impulse wheel operating under the available head at the plant.

The oil is picked up from the receiver tank and delivered into a pressure tank supplying the governor actuators, a pressure of about 150 lb. per sq.in. being used for operation. To economize in the power required for supplying this oil pressure, an unloader system is used in connection with the pressure tank and pumps in such a way that when the maximum desirable pressure is obtained in the tank, the unloader opens and permits the oil to circulate directly through the pump back into the receiver, at which time practically no power is required to drive the pump. The governors then draw their oil supply directly from the pressure tank, and when the pressure has decreased to a predetermined lower limit, the unloader automatically closes, thus putting the pump under immediate pressure and causing the oil from the pump to be delivered again into the pressure tank.

For normal operation the impulse wheel is clutch-connected to one pump and is arranged so that it discharges sufficient water to produce the full power load required by the pump. The induction motor is directly connected and thus controls the speed of the pumping set, but requires no electric energy. During the periods at which the unloader is open, the power steadily produce by the impulse wheel and which constitutes a surplus, is transmitted to the induction motor, which acts as a generator and returns energy to the system.

In this installation the hydraulic prime-mover equipment is furnished by the Allis-Chalmers Manufacturing Co. and the electric equipment by the General Electric Co. For the first hydro-electric unit the gate valves have been built by the Joshua Hendy Iron Works, of San Francisco, who were permitted to use the type of valve indicated in Fig. 5, as developed by the Allis-Chalmers Manufacturing Co. in 1913 for the Big Creek

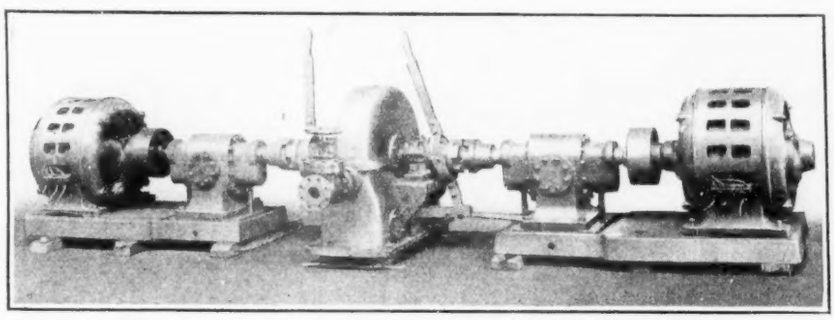


Fig. 7—Rotary oil pumps, driven by induction motors or impulse turbine, that will supply oil pressure to operate governors

Plants Nos. 1 and 2, of the Pacific Light & Power Corporation, now the Southern California Edison Company.

The project was designed and constructed by the construction department of the San Joaquin Light & Power Corporation, with Harold K. Fox, superintendent of construction; J. W. Jourdan, designing engineer; R. L. Bryant, resident engineer; and J. D. McDougald, general foreman.

The Most Important Thing in Welding*

By S. W. Miller†

I WANT to say first that fusion welding is in no way different from any other operation, because any operation can be either a success or a failure. It is true that the manipulation of the welding blowpipe is different from that of a lathe or other machine, but the same principle underlies both operations. Stated briefly, it is that the procedure used must be correct if success is to be desired, and it is at once evident that as procedure involves a number of elements. each one of them must be correct if the process is to be successful.

Some one will point out that I am not going to speak of only one thing, but of many things. I am willing to agree with him. An apple is composed of a number of elements and chemical compounds, but we have no difficulty in distinguishing an apple from other articles. In the same way procedure is made up of a number of elements, but we should have no difficulty in classifying procedure as one particular thing.

I consider that procedure involves everything that has to do with the making of an article, and in general, the following elements may be considered as essential to procedure, regardless of what is being made: (1) Design, (2) materials, (3) methods, (4) operators, (5) supervision, (6) tests. I might elaborate at great length on each one of these items in connection with welding, but will content myself with putting into as few words as possible what I have to say.

1. *Design*—This must be such as will enable the welder to weld easily and cheaply and to do good work. Designs suitable for other forms of joining than welding are frequently very unsuitable for welding, and it is necessary for the designer to forget the other types of joinings and to learn to use those suitable for welding.

2. *Materials*—These must be such as will result in clear, sound welds, so that both the base metal and the welding rod must be selected with this in view. Also the welder must be considered, because, while he may be able to use materials that are hard to weld and while it might be necessary in some cases to do this, yet for general work this should be avoided and materials should be selected accordingly.

3. *Methods*—This refers particularly to the use of suitable jigs, fixtures, clamps and other tools and to the order and way in which the various parts of the whole operation, including the preparation and finishing, are performed. Any of these things that make it easier to get better work, are an advantage, and each design should be studied with this in view.

4. *Operators*—As in all other cases much depends on the operator, but if he is handicapped by improper design, materials or methods, the best results cannot be expected, no matter how good he is. I disagree with the idea that the operator is the most important link in the chain. I do not think that any one of the items mentioned is of superior importance to the others.

5. *Supervision*—As in any other work competent and careful supervision is necessary and the supervisors must be competent to perform their duties. The supervisor should know not only the actual welding operation, but all other parts of the work.

6. *Tests*—A weld cannot be inspected internally to determine its quality, but it has been amply demonstrated that tests can be devised that will prove the integrity of the welded structure, provided the other links in the chain receive the proper attention. There are many other structures to which the same statement applies. One of the best illustrations is concrete. There is no way of inspecting the interior of concrete, and procedure control in its construction is necessary and has been carried to a very high degree of development. The testing of concrete structures is done in practically the same way that welds are tested, by applying a test load of more than the normal working load, and it has been found by experience in both concrete and welding work that when the procedure is proper, safe results are always obtained.

Procedure control in welding has shown its value in many cases not only in better work, but in reducing the cost and increasing the production. I strongly believe that it is the most important thing in welding.

*Paper presented at the International Acetylene Association Convention, Chicago, Nov. 11, 1926.

†Consulting engineer, Union Carbide & Carbon Research Laboratories, Inc.

"Double Extra Strong" Pipe Covered in Code Revisions

"Extra Strong" pipe covered all power-plant requirements until the recent application of extremely high pressures created a demand for still heavier pipe. To meet this demand the A.S.M.E. Boiler Code Committee has prepared tentative standards for "Double Extra Strong Pipe" the wall thickness being double that for "Extra Strong Pipe" for 6-in. pipe or less. The accompanying table is Table S5 of the present code with the last two columns added as proposed.

STANDARD WEIGHTS AND DIMENSIONS OF WELDED AND SEAMLESS STEEL PIPE

Size (Nominal Inside Diameter), In.	"Standard" Pipe				"Extra Strong" Pipe		"Double Extra Strong" Pipe	
	Outside Diameter, In.	No. of Threads per In.	Thickness, In.	Weight of Pipe per Linear Foot, Threaded and with Couplings, Lb.	Thickness, In.	Weight of Pipe per Linear Foot, Plain Ends, Lb.	Thickness, In.	Weight of Pipe per Linear Foot, Plain Ends, Lb.
⅛	0.405	27	0.068	0.25	0.095	0.31	.....	.....
¼	0.540	18	0.088	0.43	0.119	0.54	.....	.....
⅜	0.675	18	0.091	0.57	0.126	0.74	.....	.....
½	0.840	14	0.109	0.85	0.147	1.09	0.294	1.71
¾	1.050	14	0.113	1.13	0.154	1.47	0.308	2.44
1	1.315	11½	0.133	1.68	0.179	2.17	0.358	3.66
1¼	1.660	11½	0.140	2.28	0.191	3.00	0.382	5.21
1½	1.900	11½	0.145	2.73	0.200	3.63	0.400	6.41
2	2.375	11½	0.154	3.68	0.218	5.02	0.436	9.03
2½	2.875	8	0.203	5.82	0.276	7.66	0.552	13.70
3	3.500	8	0.216	7.62	0.300	10.25	0.600	18.58
3½	4.000	8	0.226	9.20	0.318	12.51	0.636	22.85
4	4.500	8	0.237	10.89	0.337	14.98	0.674	27.54
4½	5.000	8	0.247	12.64	0.355	17.61	0.710	32.53
5	5.563	8	0.258	14.81	0.375	20.78	0.750	38.55
6	6.625	8	0.280	19.19	0.432	28.57	0.864	53.16
7	7.625	8	0.301	23.77	0.500	38.05	0.875	63.08
8*	8.625	8	0.277	25.00	.....	.....	0.875	72.42
8	8.625	8	0.322	28.81	0.500	43.39	.....	.....
9	9.625	8	0.342	34.19	0.500	48.73	.....	.....
10*	10.750	8	0.279	32.00	.....	.....	.....	.....
10*	10.750	8	0.307	35.00	.....	.....	.....	.....
10	10.750	8	0.365	41.13	0.500	54.74	.....	.....
11	11.750	8	0.375	46.25	0.500	60.08	.....	.....
12*	12.750	8	0.330	45.00	.....	.....	.....	.....
12	12.750	8	0.375	50.71	0.500	65.42	.....	.....

*Unless specifically stated on the order, the lighter weights will not be furnished. Weights given in the table are for pipes up to and including 12 in. in nominal inside diameter, with threaded ends and couplings; sizes larger than those shown in the table are measured by the outside diameter and will be furnished with plain ends unless otherwise specified; for such sizes it will be necessary to accept manufacturers' weights or calculate the weights on the basis of one cubic inch of steel weighing 0.2833 lb.

Corrosion by Flue Gases

By A. G. CHRISTIE

THE deductions here presented are admittedly based on fragmentary data. They are offered to engineers to form a picture of the quantities which may be involved in corrosion, and which have not received much attention to date. It is hoped that they may stimulate discussion and research to prevent acid formation or developments to resist its corrosive action.

A TROUBLESOME factor in the operation of many power plants is the rapid corrosion of metal parts by the action of certain constituents of the flue gases. Corrosion usually occurs in parts where the gases have been cooled down to relatively low temperatures, as in economizers, air preheaters, breechings and steel chimneys. Special measures are usually taken to prevent such corrosive action, as for instance: Chimneys are lined with brick, breechings and ducts are coated with gunite, and metal-coated tubes and sheets are used in economizers and air preheaters. These preventive measures add to the plant cost but are usually considered necessary.

Corrosion by flue gases has been prevalent in plants that use coals or oils high in sulphur. It is now generally recognized that corrosion is due to the oxidation of the sulphur in the fuel not only to sulphur dioxide, but also to sulphur trioxide, which forms sulphuric acid on the exposed surfaces. However, little information is available regarding the relative amounts of the two sulphur compounds that may be present in the flue gases.

Report on Refractories Service Conditions

A recent progress report of the American Society of Mechanical Engineers on "Refractories Service Conditions in Furnaces Burning Pittsburgh Coal on Chain Grates," (*Mechanical Engineering*, November, 1926) contains some data of much interest in this connection. Tests were made on certain refractories in a furnace with a chain-grate stoker. The fuel used was an Ohio run-of-mine coal containing 3.4 per cent of sulphur. Analyses of the furnace gases were made at certain points to study their effects on the refractories. The furnace gases were also analyzed for SO_2 and SO_3 contents at distances varying from 1 in. to 6 in. from the furnace walls, as previous work had indicated that the ratio of SO_3 to SO_2 was greater at the brick face than in the body of the furnace. If this were true, it might indicate that the hot surface of the refractories had a catalytic effect in promoting the oxidation of SO_2 to SO_3. The series of observations with varying air supply are shown in the table which is here reproduced from the progress report. The authors of the report conclude that there is no definite evidence from these observations that catalytic action does or does not occur. They state that the SO_2 and SO_3 contents of the gases varied greatly for various positions in the side wall and for duplicate samples at one position and rating. The cause and nature of the formation of SO_3 in the flue gases is hence not evident from this report.

The figures in the table indicate conclusively that SO_3 may occur in relatively large quantities in a considerable proportion of the flue gases. If one can assume, for the moment, that the gases shown are representative of all the gases leaving the furnace, some interesting deductions may be formed which lead to surprising conclusions.

COMPOSITION OF FURNACE GASES

Boiler Rating, Per Cent	Grams per Cubic Foot of Gas		Partial Gas Composition, per Cent by Volume				
	SO_2	SO_3	CO_2	O_2	CO	H_2	N_2
120	0.0747	0.0284	9.2	8.5	0.7	0.7	80.8
130	0.1052	0.0326	10.1	6.3	0.8	0.4	82.1
125	0.0110	0.0088	3.4	17.1	0.0	0.0	79.5
125	0.0121	0.0282	4.1	16.7	0.0	0.0	79.2
125	0.0160	0.0086	5.3	15.2	0.0	0.0	79.5
118	0.0197	0.0283	7.1	13.1	0.0	0.1	79.6
127	0.0065	0.0046	0.8	19.6	0.0	0.0	79.6
118	0.0274	0.0795	11.2	5.5	0.0	0.0	83.2
125	0.0795	0.0073	14.2	1.9	0.7	0.7	82.4
130	0.0920	0.0310	11.0	5.7	0.1	0.3	82.8
122	0.0260	0.0223	11.4	5.1	0.5	0.3	82.6
115	0.0017	0.0432	6.8	13.3	0.0	0.0	79.9
155	0.0014	0.0024	5.7	14.7	0.0	0.0	79.6
145	0.0103	0.0041	5.3	15.3	0.0	0.0	79.4
150	0.0245	0.0140	13.5	3.7	1.1	0.1	81.6
145	0.0454	0.0432	13.1	1.7	1.6	0.9	82.6
155	0.0495	0.0168	12.4	5.1	0.0	0.0	82.4
165	0.0835	0.0441	9.8	8.8	0.0	0.2	81.0
160	0.0649	0.0304	13.5	3.2	0.0	0.0	83.2
165	0.0663	0.0828	13.3	2.5	1.5	0.4	82.1
186	0.0742	0.0179	10.9	0.6	4.2	2.8	81.4
188	0.0943	0.0000	10.1	0.4	5.4	5.8	78.2
185	0.0347	0.0279	8.1	12.0	0.0	0.0	79.9
187	0.0035	0.0110	6.3	13.3	0.0	0.0	80.4
175	0.0162	0.0400	13.0	4.9	0.8	0.1	81.1
189	0.0435	0.0266	10.8	8.3	0.0	0.0	80.8
180	0.0018	0.0067	2.3	18.7	0.0	0.0	79.0
190	0.0088	0.0142	2.5	18.3	0.0	0.0	79.2
175	0.0952	0.0242	13.9	4.5	0.8	0.4	80.3
178	0.0172	0.0298	12.0	3.5	1.3	0.5	82.6
192	0.0075	0.0173	12.5	4.5	0.0	0.0	83.0
180	0.0928	0.0295	11.4	6.8	0.2	0.1	81.3

The average weight in grams per cubic foot of gas for all observations in the table are SO_2 0.04085 and SO_3 0.02518. The molecular weight of sulphur is 32 and of oxygen 16. Hence the relative weight of sulphur burned to SO_2 is $\frac{32}{64} \times 0.04085 = 0.02042$ grams per cu.ft. and of sulphur burned to SO_3 is $\frac{32}{80} \times 0.02518 = 0.01007$ grams per cu.ft. The ratio of the weights of sulphur burned to SO_2 to sulphur burned to SO_3 is as 2.03 to 1. This would indicate that approximately one-third of the sulphur in the coal has burned to SO_3.

The boiler on which the tests were made was of the Stirling type and contained 6,865 sq.ft. of heating surface. The boiler load at 150 per cent rating is given in the report as 34,500,000 B.t.u. per hr. No figures are given on the efficiency of this unit. The coal contained 12,290 B.t.u. If an efficiency at this rating of 74 per cent may be assumed, the coal burned per hour would be

$$\frac{34{,}500{,}000}{.74 \times 12{,}290} = 3{,}790 \text{ lb.}$$

Let us next assume that all the 3.4 per cent sulphur in the coal is burned to SO_2 or SO_3; the total sulphur

burned per hour would be $0.034 \times 3{,}790 = 128.9$ lb., or 3,094 lb. per 24 hours. The proportion burned to SO_3 would be $\frac{1}{3.03} \times 128.9 = 42.5$ lb. per hour.

The flue gases will contain water vapor which has come either from moisture in the entering air and raw coal or from the combustion of the hydrogen content of the volatile matter. This water vapor at the temperature of the flue gases will combine with the SO_3 gases to form sulphuric acid (H_2SO_4) which in the concentrated liquid state is quite corrosive. If this acid remains in the vapor form, it will pass out with the flue gases and will do no harm. This is generally the case with boilers where no heat recovery apparatus is placed in the flue gases. In such a case the temperature of the flue gases is 500 deg. F. or higher, and the sulphuric acid passes out the chimney as a vapor. It has been stated that the dew point of sulphuric-acid vapor varies from 180 to 500 deg. F. depending on its degree of concentration, that is, on the amount of additional water vapor that it has absorbed. It is therefore probable that economizer and air preheater surfaces may cool the flue gases sufficiently to cause some or all of this more or less concentrated acid to precipitate on certain exposed metal walls. This is undoubtedly the cause of the corrosion frequently experienced with such equipment.

Quantity of Acid

It is interesting to consider the quantities of such acid that may be formed under the assumed conditions. Again using atomic weights, one pound of sulphur will form $\frac{98}{32} = 3.06$ lb. of sulphuric acid (H_2SO_4). At the assumed load there will be formed $3.06 \times 42.5 = 130$ lb. of sulphuric acid per hour, or 3,120 lb. per 24 hours. Under these extreme assumed conditions this boiler alone would discharge the astonishingly large amount of 1.56 tons of sulphuric acid per 24 hours in its flue gases.

This maximum quantity of acid is probably not formed, for the following reasons: In the first place, one cannot safely assume that the refractory walls have no catalytic effect in oxidizing SO_2 to SO_3; in fact, it is probable that such catalytic action takes place. It is also probable that the content of SO_3 in the whole mass of flue gases is less than indicated by the average of the figures in the table. It is regrettable that analyses of all the gases leaving the furnace are not available. In the second place, all the sulphur may not be burned to gas form. Undoubtedly, some remains in the ash as sulphides and sulphates. If cold water is sprayed on hot ash, a smell of sulphur gases can be noticed in the resulting vapor indicating the presence of a certain amount of sulphur in the ash. Little data are available in regard to the total that remains in the ash. If a liberal allowance is made for these two factors, there will still remain a substantial quantity of sulphuric acid to be discharged each day with the flue gases. This acid presents a real problem to designing and operating engineers.

Up to the present time there has been no cheap way developed to remove all of the sulphur from the coal. Washing helps to a considerable extent.

A plan to remove pyrites from coal is now under investigation. This holds considerable promise, for the withdrawal of the pyrites would also remove a large part of the iron in the ash and thus raise its fusing temperature. This would improve the burning qualities of many mid-Western coals. No plan has been suggested to remove the native sulphur from the coal. Lessing has called attention to the effect of catalyzers in the combustion of coal, and a substance may yet be found which, while permitting the burning of sulphur to SO_2, will exert catalytic power to prevent its further oxidation to SO_3. New types of furnaces with water-cooled walls will exert less catalytic effect in producing SO_3 than those with refractory walls. With our present state of knowledge there does not appear to be any method available to prevent wholly the formation of some SO_3 and of sulphuric acid in the flue gases.

The only method now proposed to remove SO_3 or sulphuric acid from flue gases is by washing. This cannot be done until all heating surfaces have been passed over by the gases or a loss of heat will result. Hence washing does not appear to be a preventive of corrosion in economizers and air preheaters.

All engineers must recognize that the discharge of such acid vapors in flue gases into the atmosphere will have a serious economic effect in promoting corrosion of buildings and various structures, and on vegetable and animal life. The prevention of this destruction may justify the washing of all flue gases before they leave the chimney.

Certain volatile salts of iron may be formed in the combustion of coal that may later condense in the flue gases and lead to corrosive effects when combined with the sulphur gases. Among these are iron carbonyl and iron chloride. Little is known of the formation or effects of these salts in boiler practice, although they are known to occur in gas making and to lead to corrosion in gas mains.

With regard to the corrosion of power-plant equipment only such measures can be taken that will provide surfaces to withstand corrosive action. It would be interesting to know whether any particular form of air preheater is more immune to acid attack than others. It seems necessary with relatively cold economizer tubes to use an acid-resisting metal. Breechings, stacks and connections may be protected by gunite or similar coatings.

Continuous Blowdown Apparatus

With the evaporation of water in steam boilers the pure water leaves the boiler as steam and the dissolved or suspended impurities originally present in the makeup water remain in accumulating amount.

To avoid uneven operation caused by the large variation in concentration which is brought about by heavy periodical blowdowns, various systems of continuous blowdown have been suggested. This increases the smoothness of operation as it tends to insure a constant density of the boiler water.

An ingenious application of this principle which appears to have met with favorable consideration in foreign installations, consists of a combination continuous blowdown and sludge-removal system from which the heat is recovered and returned to the boiler through application to the incoming feed water. It is claimed that such a device makes it possible to maintain continuously in the boiler the best conditions for smooth steam generation and permits a close control over the variations in the salt and sludge concentration. Claims are also made that the heat lost by ordinary periodic blowdowns is largely conserved and that 15 to 20 per cent of the water removed is recovered as condensate.

What Europe Is Doing in Steam Turbine Design*

SHORTAGE of fuel dictates designs for maximum economy. Four turbine cylinders are provided in 85,000-kw. turbine generator now under construction. There is a strong demand for industrial turbines and geared sets.

AS A result of improvement in design, better workmanship and material of higher quality, the possible capacity of steam turbines at different speeds has been gradually increased. In 1910 3,000 r.p.m. could be used only for capacities up to 2,000 kva., 1,500 r.p.m. up to 6,000 kva., and 1,000 r.p.m. for greater outputs. In 1922 20,000-kva. turbines had been built running at 3,000 r.p.m., and turbines larger than 50,000-kva. running at 1,000 r.p.m. Today even 30,000-kva. turbines are running at 3,000 r.p.m., and 100,000-kva. turbines, the largest now under construction, are designed for 1,500 r.p.m.

Owing to the depressed economic condition in Europe the design of turbines has of late undergone a change. Formerly, the design of prime movers was, first and foremost, influenced by the call for cheapness and minimum space, frequently at the expense of fuel consumption, but with the predominant shortage of fuel the question of maximum economy now rules all decisions.

Performance in the turbine plant may be improved on the one hand by stage bleeding of part of the steam of the turbine for preheating the feed water; on the other hand by re-superheating the working steam. The latter proposition has until now not gained much ground in Europe, as it results in a decidedly more complicated plant. As a compromise, feed-water heating by steam extraction from a few stages of the turbine in conjunction with economizers is the generally accepted practice in our modern power stations, as it has become in America.

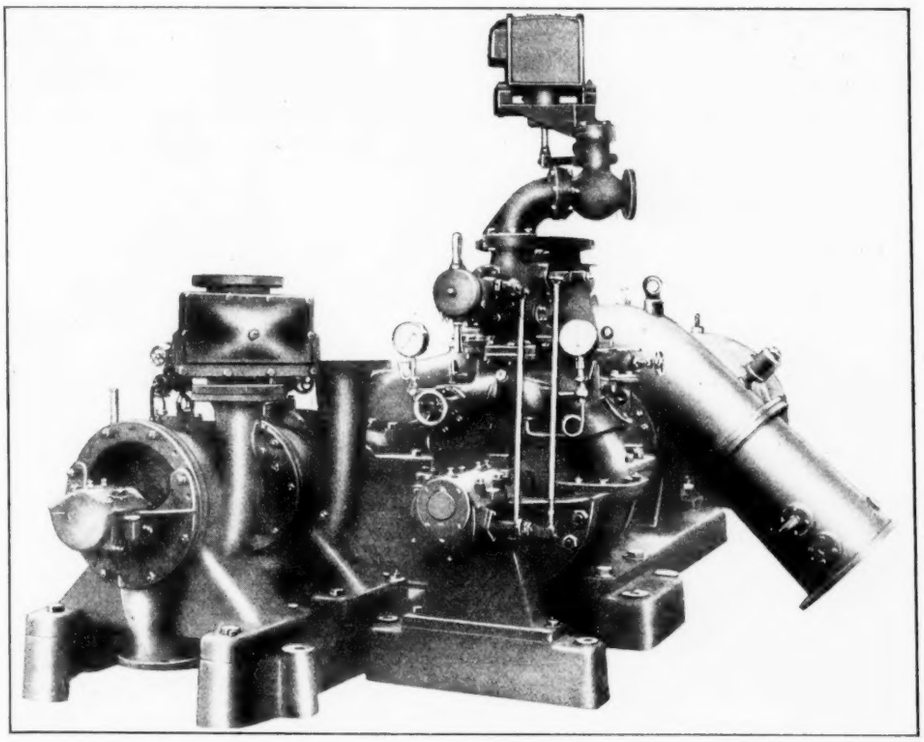


Fig. 1—This group of condenser pumps is dually driven by an electric motor with a geared turbine for emergency

Design Features

These considerations lead to the result that since high steam economy is of prime importance and other points of view are secondary, low steam velocity, and in consequence the multi-stage turbine, is superior to the turbine with high steam velocities and a smaller number of stages.

While turbines for low and medium output and for medium pressures are usually built within one casing, those for high steam pressures are in many cases advantageously designed with two or more cylinders, on account of the larger adiabatic heat drop. This type of construction is naturally more expensive and requires more space than the single cylinder, therefore can be used only for the larger turbines.

With a high vacuum the steam volume to be disposed of is so large that even with medium outputs it is best to resolve the last stages into two parallel paths, as otherwise it would be difficult to secure safely sufficient area for the exhaust end.

In summarizing the reaction and impulse systems of blading, one comes to the conclusion that the impulse principle is best suited for the high-pressure part and for the smaller steam volumes, and the reaction principle for the low-pressure part and for the greater steam volumes. Accordingly, most builders of impulse and reaction turbines are approaching each other from opposite directions.

Another point to be taken into consideration is that

*This article is based on a lecture delivered at Harvard University by Dr. E. A. Kraft, professor at the University of Berlin and chief engineer of the Turbine Factory, A. E. G., Berlin.

shafts that run below the critical speed give the best guarantee for quiet running of the turbines. Overcritical shafts may be used, if at all, only when the temperatures are low and the dimensions of a turbine are small, because only here perfect homogeneity of the material and symmetrical expansion under the influence of heat may be expected. The rigid shaft has the great advantage that the labyrinth packings and the diaphragms can be made to work with minute clearances without excessive danger.

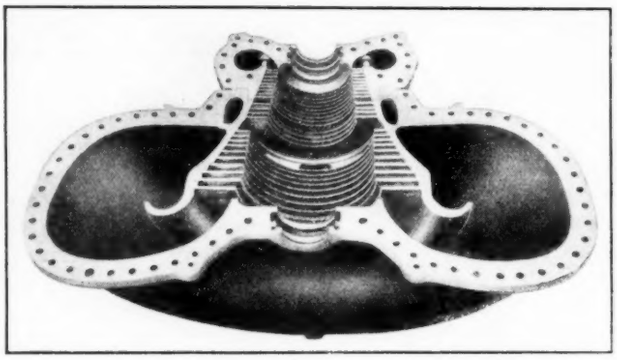


Fig. 2—Design of the exhaust as a diffuser reduces the leaving losses

This is of special importance for high-vacuum turbines.

Only when the lowest pressure is just behind the last turbine stage can the whole adiabatic heat drop be used within the active part of the turbine. Therefore the exhaust end of the turbine, the steam passage to the condenser, has to be designed very carefully to avoid loss of steam pressure by throttling and friction along the walls. This is the more important the higher the velocity of the steam leaving the last blades, as the flow losses increase under like conditions with the square of the steam velocity. For this reason the exhaust end of the turbine must be shaped as a diffuser.

Condensing Turbine Generators

The Allgemeine Elektricitats-Gesellschaft, of Berlin, has up to now built a total of ten million kilowatts in turbine-generators. In the year 1925 152 turbines were ordered, representing a total power of over 800,000 kw. The most important and most interesting turbine plant now being built is for a new superpower station in the suburbs of Berlin. The unit will have a maximum rating of 85,000 kw. The most economical rating is 70,000 kw. Four turbine cylinders are provided. A high-pressure and an intermediate-pressure cylinder are arranged in tandem, driving a single generator. There are two low-pressure cylinders in tandem, driving the second generator. The speed of both generators is 1,500 r.p.m. The initial steam pressure is 500 lb. per sq.in. absolute, and the steam is superheated to 750 deg. F. The division of the turbine into four cylinders decreases the temperature drop per cylinder and entirely obviates distortion due to inequalities of temperature.

In spite of the considerable increase in the number of stages the kilowatt weight of this four-cylinder unit is somewhat less than that of smaller single-casing turbines. In the first stage a small Curtis wheel is installed. The remainder of the high-pressure and intermediate-pressure bladings consists of 30 stages of simple, pressure compounded, impulse type. The two low-pressure turbines have 24 stages of reaction blading in each, and the steam flows through the two casings in opposite directions in order to eliminate the axial thrust. In order not to complicate the whole set, reheating of the working steam and bleeding the main turbine has not been used. The feed water will be preheated by extracted and exhaust steam from a separate house turbine.

Industrial Turbines

In the trend for higher economy there is also a steadily increasing demand for back pressure, bleeding-back pressure and bleeding-condenser turbines, in which the

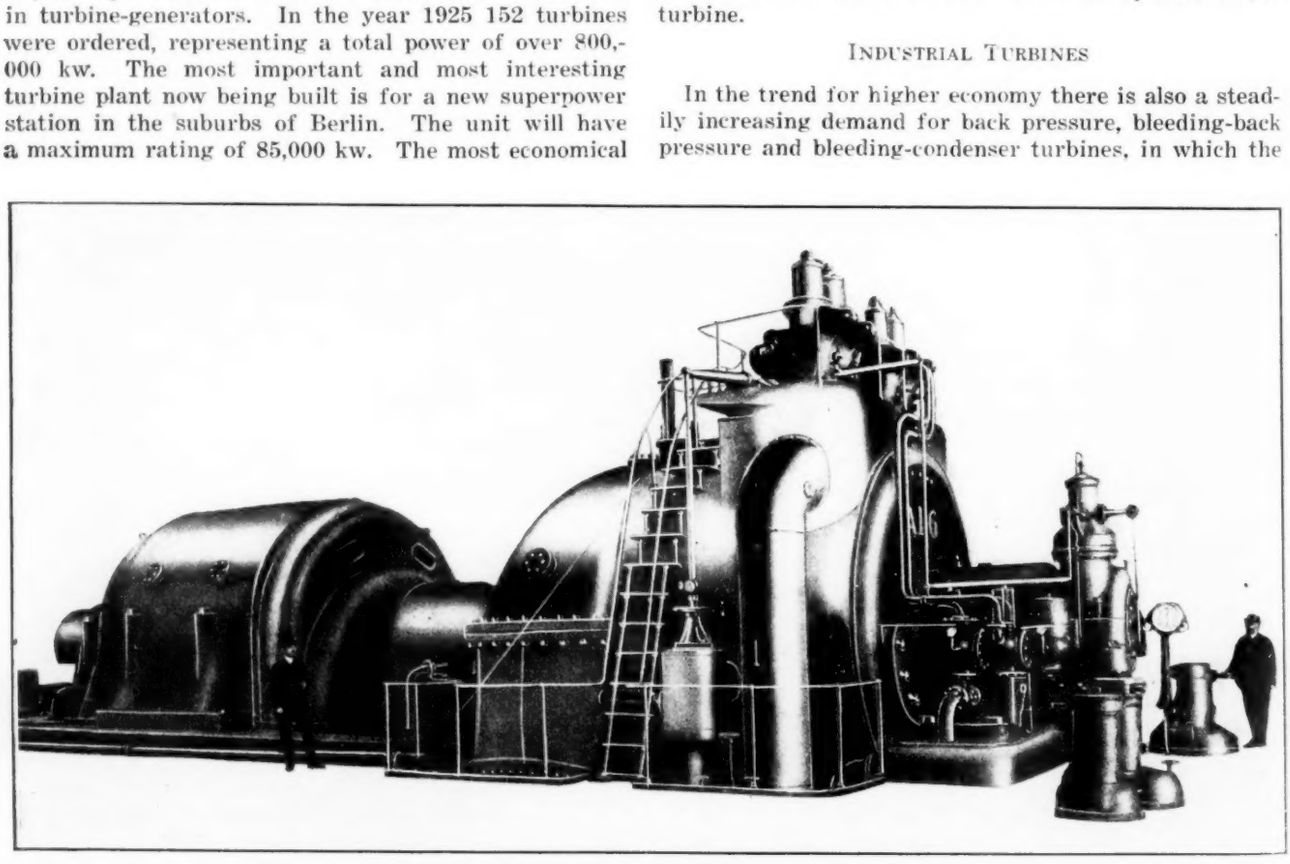


Fig. 3—The largest single-casing turbines on the Continent have an output of 50,000 kw. and run at 1,000 r.p.m.

heating steam necessary for industrial plants can be expanded.

In the United States the industrial turbine is not as common as on the Continent. In Europe there exists a large number of smaller independent power stations which produce the energy for the vicinity, and for

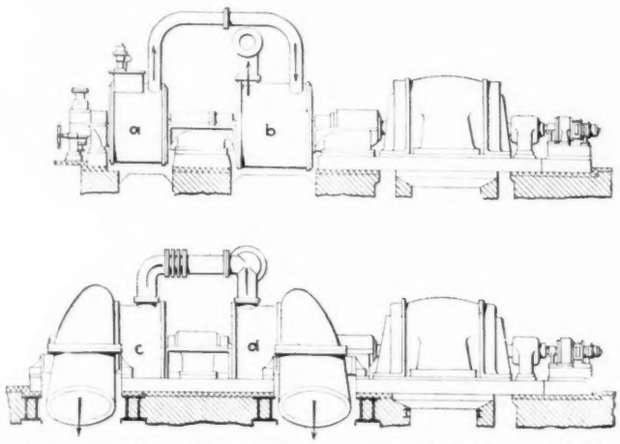


Fig. 4—Berlin will soon be served by this four-cylinder 85,000-kw. unit

c indicates the high-pressure turbine, *b* the intermediate, and *c* and *d* the two low-pressure turbines, each exhausting to a condenser through two exhaust openings, one on either side of the shaft center-line.

individual factories, and at the same time deliver steam for heating purposes to the factories. This coupling of the demand for electrical energy with that for heat-steam results in a more economical plant.

The Geared Turbine

With small output it is practicable to raise the speed of the turbine. High velocities increase the output of the turbine without increasing the weight. As the economical speed of the driving and the driven apparatus sometimes differs widely, it is impossible to connect both directly without seriously affecting the efficiency of one of the parts. The interposition of a reduction gear is an especially suitable means of adapting the economical speed of turbines to the most favorable speed of the driven machine.

Of all types of speed reducers, hydraulic, electric, and mechanical, thus far tested, mechanical gears have proved not only the simplest and most efficient means of reduction, but also the best adapted in most cases because of their almost unlimited range of speed reduction.

Reduction gears make it possible to run small turbines at high speed, thus reducing the diameter of the high-pressure parts with consequent decrease in leakage and frictional losses. Geared high-speed turbines have a promising future since they extend the field of efficient application of the steam turbine to work for which it would be unsuitable with direct connection. This practice leads to smaller dimensions, smaller weights and lower stresses due to steam pressure and thermal expansion.

The friction losses of modern single reduction gears for medium output amount to only 1 or 2 per cent of the transmitted load, including the losses of the bearings. The losses of a double reduction gear go up to 3 to 4 per cent. The increased over-all efficiency of the set may easily overbalance the friction losses of the gears. Further, the reliability of the set is no longer affected in any way by the gears. When planning a set, one must always consider whether the use of reduction gears may be reasonably advantageous.

It should be mentioned that the higher pressures and temperatures now frequently employed call for superior materials. Cast steel is widely used, likewise heatproof cast iron of high mechanical strength, high-grade alloy steels and special kinds of brass for the blading. One must always bear in mind that high temperature lowers the strength and the modulus of elasticity of some materials. Increased outputs and speeds have also rendered necessary increased attention to vibration phenomena.

The Aim and Means of Future Progress

The object of present endeavor is the design of turbines with high efficiencies. The use of higher steam pressure and temperature, with the consequent higher stresses in the material, the complicated governing systems of mixed pressure and extraction turbines, and the necessity of attaining maximum efficiency with minimum material—all these considerations involve many problems. Turbines of high efficiency demand more care of the designer and more accuracy of the workman. Each carelessness or fault detracts from the final performance.

Through the tireless work of the engineer the steam turbine has developed enormously within less than a generation. It has decidedly influenced the energy problems of civilized countries and increased enormously the capacities of power stations. The cost of power has been reduced markedly, and the turbine has not yet

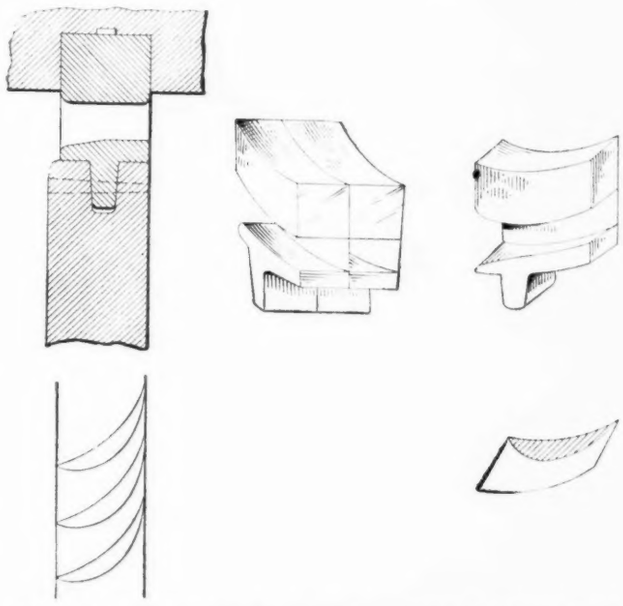
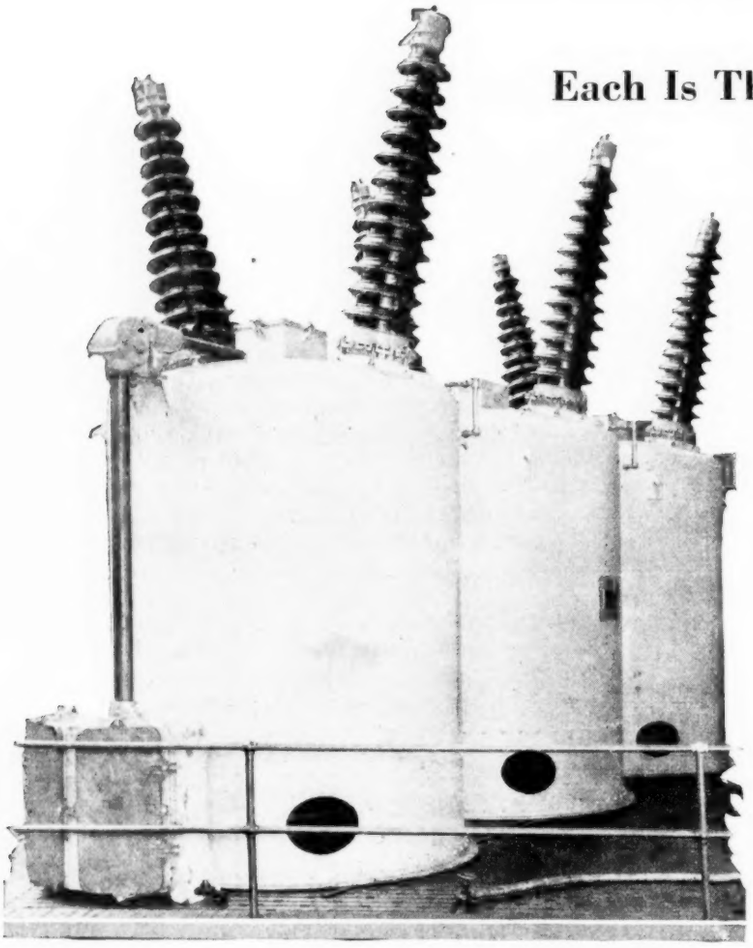


Fig. 5—Stainless-steel nozzles machined throughout reduce friction losses

reached its goal in the race for the B.t.u. The development of turbine design reflects the movement of fuel prices and general economic conditions. Cheap fuel leads to simple machines, costly fuel to increased refinements to reduce steam consumption. Behind all changes in design is the constant endeavor to develop a prime mover of absolute reliability and maximum economy. Efforts toward this end have more and more standardized recent construction, since as the ideal is approached a multitude of forms must disappear.

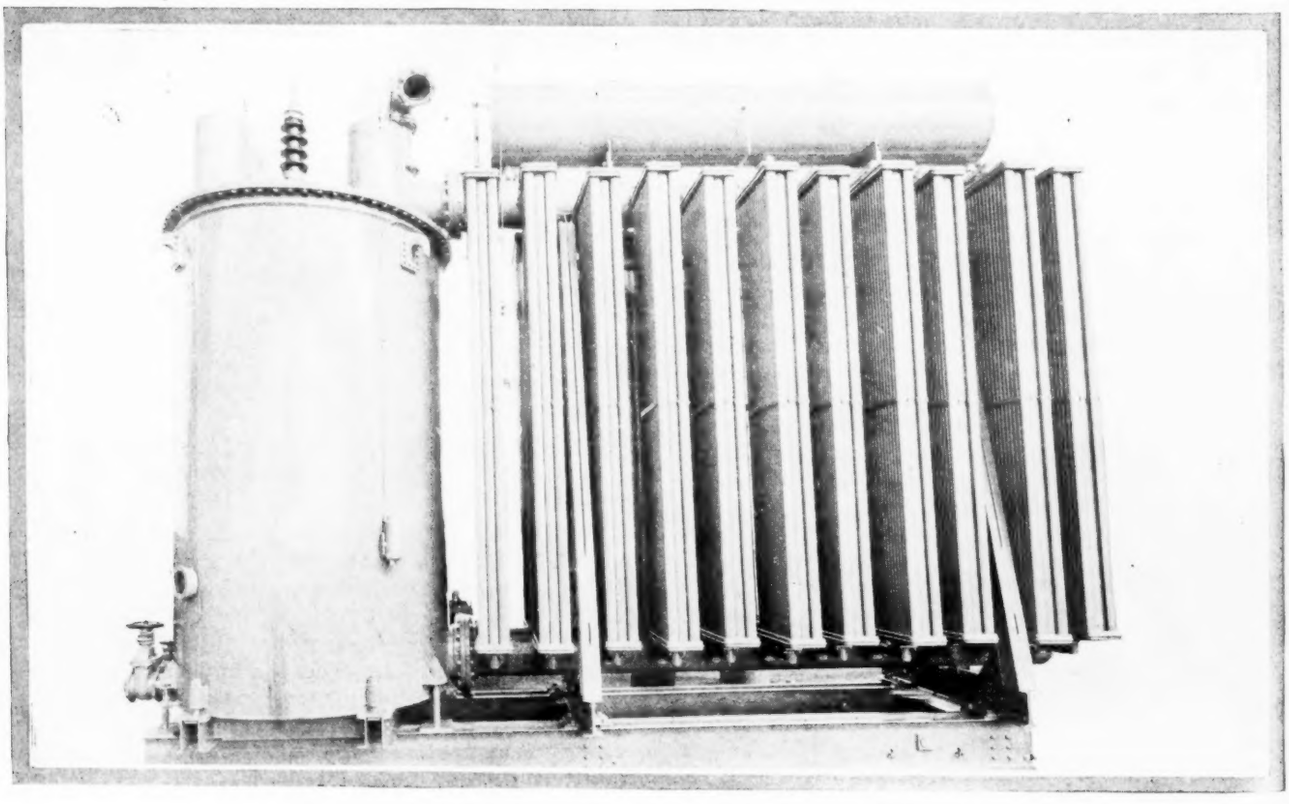
Each Is The Largest Of Its Kind



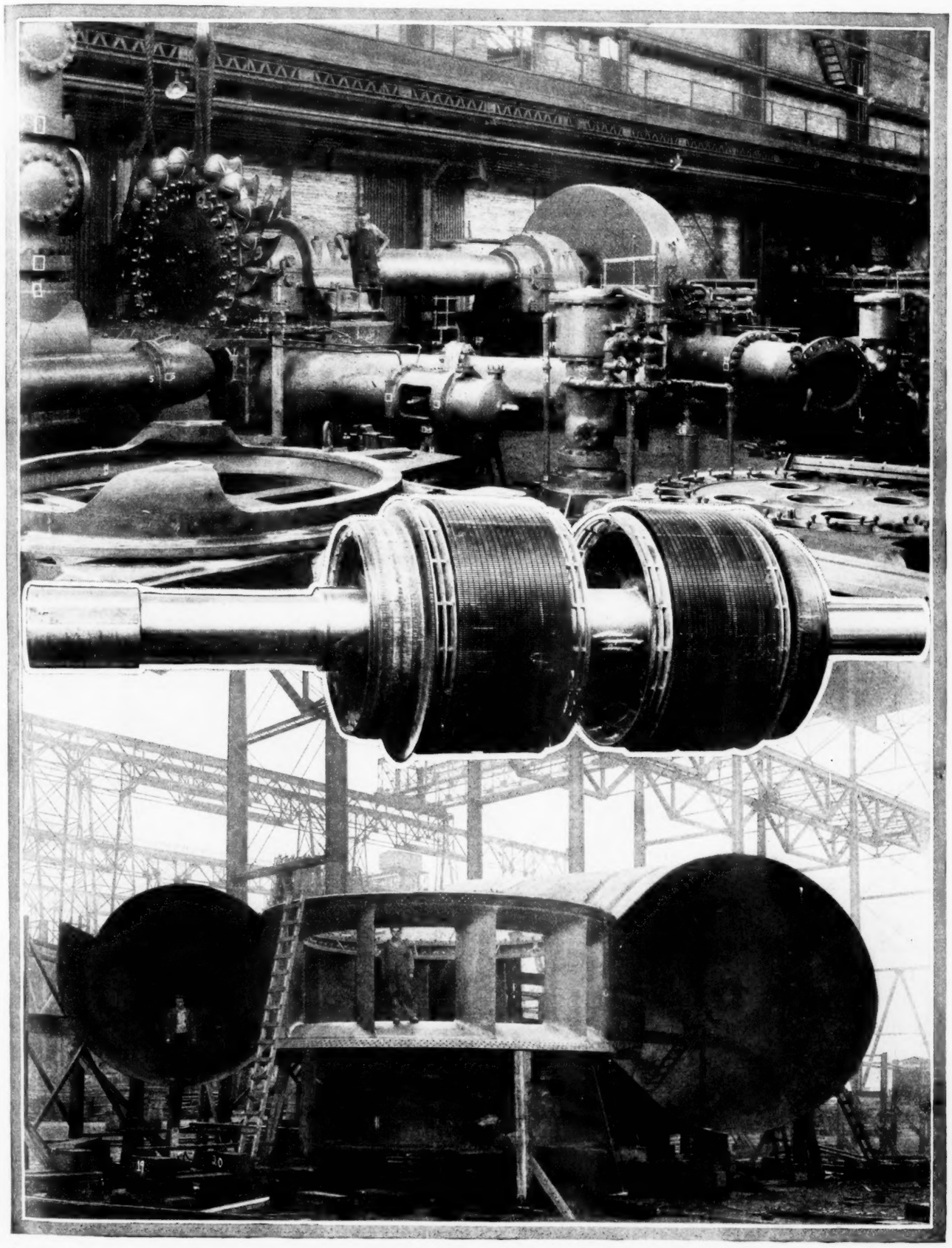
Left—The three phases of the world's largest circuit breaker, rated at 220,000 volts and designed to rupture 2,500,000 kva. on short circuit. Installed and full of oil they weigh 85 tons.

Below — The 89,000-kw. transformer bank of which this is a part includes the largest transformers on which separate radiators have been mounted. The unusual arrangement of the radiators was made necessary by space limitations

Photos on this page by courtesy of Westinghouse Electric & Mfg. Co.



Three Big Jobs in The Power Field



Top—Shop assembly of 40,000-hp., 2,243-ft.-head, Allis-Chalmers impulse unit for Kings River Development. Middle—Unwound armatures of 7,000-hp., 700-volt blooming-mill motor (Allis-Chalmers). Bottom—Assembling casing of 31,100-hp., 70-ft. head, I. P. Morris turbine for the Phoenix Utility Co.

How Semi-Magnet Alternating-Current Elevator Controllers Operate*

By CHARLES A. ARMSTRONG

ELEVATORS operated by alternating-current motors are used for a wide variety of services, from slow-speed equipment up to 500 ft. per min. applications. In this article the operation of controllers used on hand-rope operated machines is explained and the construction of magnetic contactors used in this class of service is discussed.

SEMI-MAGNET controllers include those commonly known as the pull-rope type and are for slow-speed machines, generally not exceeding 100 ft. per min., because of the difficulties of manipulating the control at higher speeds. All slow-speed elevators are not controlled by semi-magnet type of controllers, but in many cases some form of full-magnet controller is used, operated from push buttons or a car switch. Semi-magnet or pull-rope type controllers are rapidly being forced out of use for open hoistway construction by safety code and insurance rates. The present installations are chiefly for freight elevators in localities where they are allowed to be used.

Control equipment for slow-speed alternating-current elevator motors may be made much simpler than the control used for a similar class of elevators driven by direct-current motors. For elevators operating with a car speed of 300 or 400 ft. per min., the alternating-current control involves as many complications as the direct-current type.

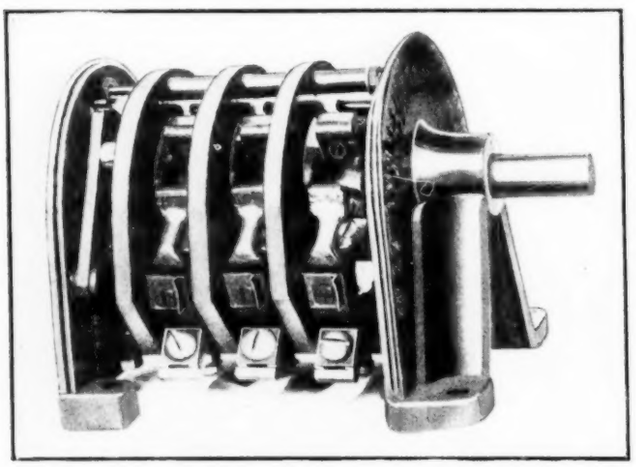
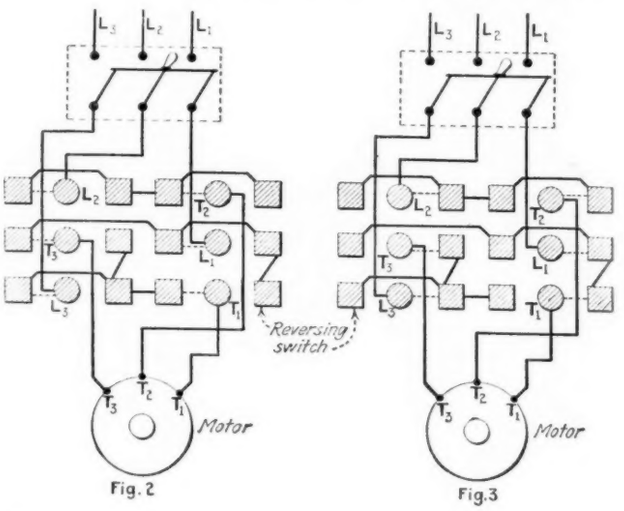


Fig. 1—Cylindrical-type reversing switch

*The equipment described in this article is that built by the Westinghouse Electric & Manufacturing Co., who supplied a large part of the data for the story.

On low-speed machines the high-torque single-speed squirrel-cage motor may be used and may be connected directly to the line when starting, or by using one or more accelerating steps of primary resistance. In all cases with direct-current motors, it is necessary to provide a means of applying reduced voltage across the armature at the instant of starting. This is generally in the form of a resistance, which is cut out of circuit automatically as the motor comes up to speed.



Figs. 2 and 3—Diagrams of cylindrical-type reversing switch connected to three-phase squirrel-cage motor

Reversing-Switch Type Control

Where the alternating-current motor is 10-hp. rating or less and the service is not heavy, and where the local safety laws permit, the control equipment may be reduced to a reversing switch. Fig. 1 shows a cylindrical type of reversing switch used for such service, and Figs. 2 and 3 show the connection diagrams for such a switch, and a three-phase motor. The switch is connected to the elevator operating mechanism by sprockets and a chain, and its position is controlled by a hand rope passing through the car. The control may be obtained by pulling directly on the rope or through the medium of a wheel or lever.

This class of control equipment is used with either an electrically operated or a mechanical brake and the terminal-landing limits on a drum-type machine are the stop balls on the operating cable, and the drum-shaft limits operated by a traveling nut. With a traction-type machine the stop balls on the operating cable are the only limits. However, with the traction machine there is the added safety feature that if either the car or the counterweights land on the bottom of the hoistway, the hoisting cables lose their traction on the sheave and

no damage is done to the equipment. If the limits failed on a drum-type machine and the car or counterweights were pulled into the overhead work, the equipment would probably be wrecked.

With the reversing switch closed to one position, as indicated by the dotted lines, Fig. 2, the flow of the current through the motor at one instant will be from L_3 line to T_1 motor terminal and L_1 to T_3 on the motor These two circuits continue through the motor's windings to T_2 and return to L_2 line. Throwing the switch to the other position, as indicated by the dotted lines in Fig. 3, connects L_3 line to T_3 on the motor and L_1 line to T_1 on the motor and will cause the rotor to run in an opposite direction from that obtained with the connections Fig. 2. This is a very simple type, but is suitable for use only on small machines. As the motor current is broken on the reversing switch, the maintenance on these contacts is higher than if a magnetic contactor, Fig. 4, were used for this purpose. This contactor may be used for motors up to 20-hp. capacity and for car speeds up to 100 ft. per min. In many localities a line contactor is required as a safety feature, and it must be arranged so that it will be opened by the over-travel limit or other safety switches.

Magnetic Main Line Switch

The diagram of connections for a magnetic contactor and reversing switch is given in Fig. 5. With the switch closed to one position, as shown by the dotted lines, the circuit through the contactor coil is made from the L_3 side of the line through the coil, the auxiliary contacts A and A' on the reversing switch and to the L_2 line. Energizing the coil causes the contactors to close, and the flow of current through the motors at one instant is indicated by the arrowheads. Throwing the reverse

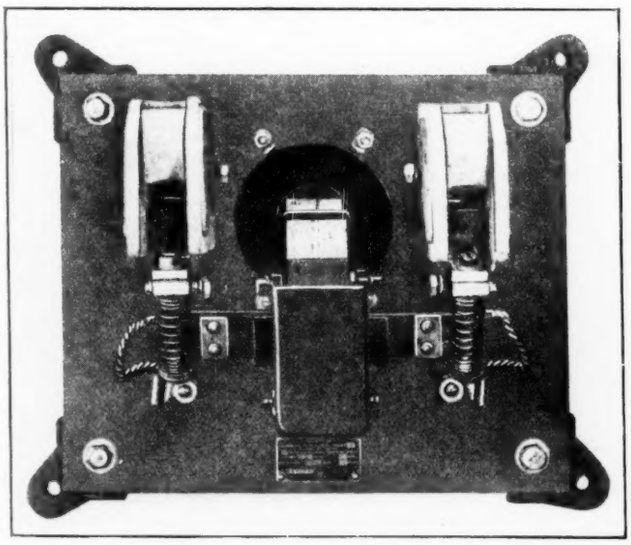


Fig. 4—Two-pole main-line magnet switch

switch to the opposite position reverses the direction of the current in phase T_1-T_2 of the motor. Auxiliary contacts A and A' on the reversing switch are made shorter than the main contacts so that the coil circuit will be broken and made and the contactor switch opened or closed before the main contacts on the reverse switch. In this way all the arcing takes place on the contactor switch, which is designed for this service. Either a single-phase or a polyphase type brake may be used, the coils for which are connected across the motor terminals as in the figure. In addition to the mechanical limits for stopping the car at the terminal landings, other protective features may be added, such as slack-

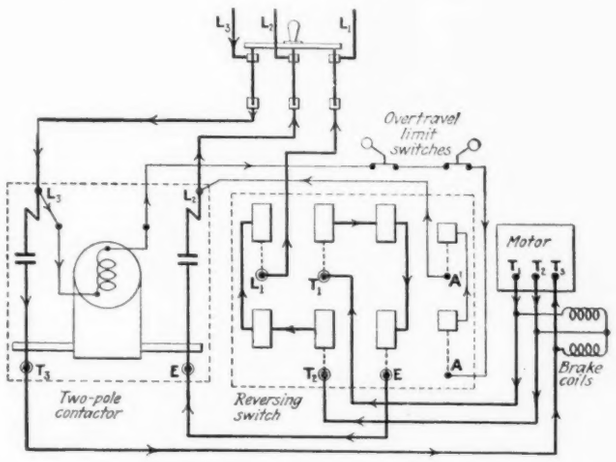


Fig. 5—Diagram of connections for three-phase motor, reversing switch and two-pole magnet switch

cable limit switches, overload relays, reverse-phase relays, door and gate contacts, hoistway limit switches, and low-voltage protection. All these are required by law in some localities and should be connected in series with the line-contactor coil.

Controller and Protective Devices

A controller arranged to embrace all the foregoing mentioned protective features is shown in Fig. 6, and the connection diagram is given in Fig. 7. The reverse-phase relay is in reality two relays so connected that they will not close in case one phase has been accidentally reversed after the relays have been properly connected.

Relay coil P_1 is connected directly across the line from L_3 on contactor C to L_1 terminal at the top of the panel. Energizing this coil caused it to close its contact and complete a circuit for coil P. This latter circuit is from L_3 on contactor C, through inductance X, contact of relay P_1, coil P to L_2 line. Inductance X forms a second circuit through resistance R and R_1 to L_1. The combined effect of these two circuits is to cause relay P to open in case of a reverse phase. The contact of relay P is in series with the coil of no-voltage relay N, therefore, if contact P opens, the no-voltage relay will drop out and cause contactor C to open and interrupt the line circuit to the motor.

Relays P and P_1 also give phase-failure protection to the motor and prevent its being connected to the line when only one phase is alive. If either line L_1 or L_3 is open, coil P_1 will not close its contact, therefore P cannot close, and the controller will remain in the off position. An open circuit in line L_2 will prevent the coil of relay P being energized, consequently its contact will not be closed. This prevents the no-voltage relay closing so that line contactor C will not function to connect the motor to the line.

The no-voltage relay prevents unexpected starting of the elevator in case of power failure if the reverse switch was left in the on position until power returned

to the line. If the reverse switch is left in the on position, it will be necessary to return it to the off position before the elevator can be started again on the return of power. A circuit for no-voltage relay coil N is from L_3 on line contactor C, through coil N to the reverse switch. With the reverse switch in the off position, a circuit is closed for coil N through contacts 69 and 70, back to the controller, then through the door contacts, slack-cable switch, car-safety switch, overtravel limits in the hoistway and the governor switch to the controller, through the contact of reverse-phase relay P and to the L_1 side of the line. If the circuit is alive, coil N closes its contact. This provides a circuit for coil N to 70 on the controller without going through the contacts on the reverse switch, and relay N will remain closed as long as the line is alive no matter what is the position of the reverse switch.

If the reverse switch was left in the on position when the power was off the line, the no-voltage relay coil circuit would be open at 69 and 70 on this switch, and relay N could not close with the return of power to the line until the reverse switch was first brought to the off position. As previously explained, this prevents an unexpected starting of the elevator.

With power on the line and the relay contacts closed, moving the reverse switch to on position, as indicated by the dotted lines, completes a circuit for coil C from

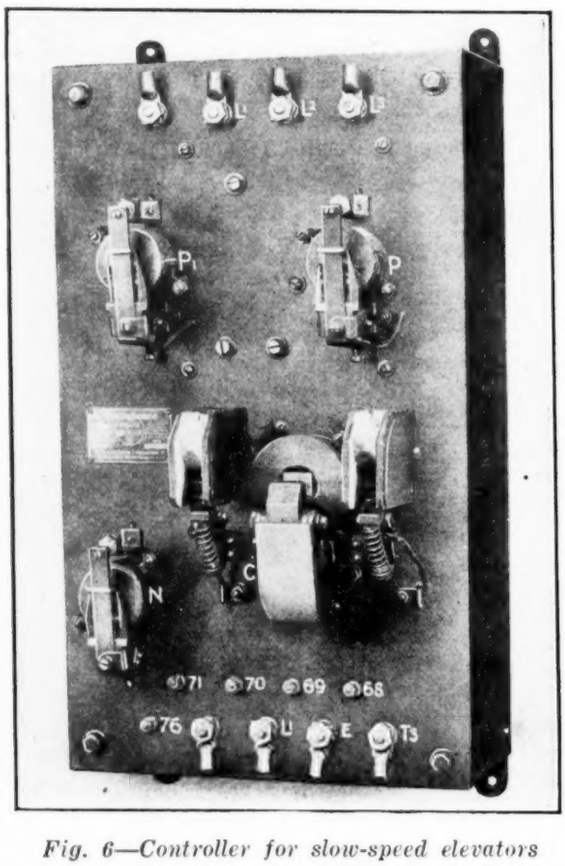


Fig. 6—Controller for slow-speed elevators

C, two-pole main-line contactor; N, low-voltage relay; P and P_1 phase-reversal and phase-failure relays

L_3 to 68 and 69 on the reverse switch, back to the contact on relay N. From here the circuit is completed through the safety devices and the contact of relay P to L_1 side of the line. Making coil C alive closes its contactor and completes the circuits for the motor.

Circuits for the motor are provided from L_2 on the line through the left-hand contact of switch C, through the motor to T_2 and T_1 on the reverse switch. From T_2 the circuit is to E, the right-hand contact of switch C and the L_2 line. The other circuit is from T_1 to L_1 contacts on the reverse switch and to the L_1 side of the line. The brake coils are connected across the motor

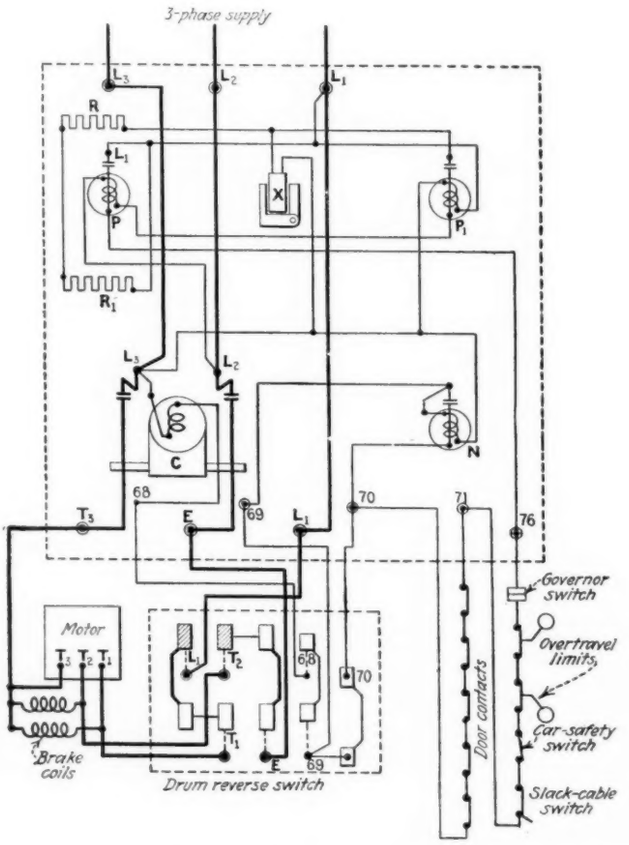


Fig. 7—Diagram of the controller, Fig. 6, connected to a three-phase motor

leads and are energized with the motor, so that the brake releases and the motor starts and comes up to speed. For the reverse operation the circuits are the same except that L_1 and L_2 are reversed in the reversing switch.

Over-Travel Limit Switches

With this type of controller and over-travel limit switches, if the regular limits fail to stop the machine at the terminal landings, the car will strike one of these switches and cause contactor C to open and stop the machine. When this occurs, the motor cannot be started from the car until it has been moved off the hoistway limit switch. This may be done by releasing the brake and turning the worm shaft by hand or by holding contactor C closed by hand and then operating the reverse switch in the usual manner to move the car with the motor. In doing this care should be exercised to start the machine in the right direction. If the cables are slack, this slack should be taken up by moving the machine by hand before attempting to move the car with the motor.

One of the problems in the successful application of alternating current to elevator service was the design

of a satisfactory magnetic contactor switch. Many of the earlier types were noisy and difficult to maintain in good condition. Because the current is alternating, the core of the ordinary type of contactor would be magnetized and then demagnetized, therefore the contactor would tend to close with a strong force at one instant and be released the next. This action tends to cause the contactor to be noisy unless properly designed. The alternating flux tends to generate heavy eddy currents in the core, which cause serious heating and reduce the effectiveness of the magnetizing current in the coil.

The latter difficulty is easily overcome by properly laminating the magnet's core, and it is for this reason that the cores of most alternating-current magnets are built up of thin sheets of iron or steel. To prevent the core from producing a humming noise, it is essential that these laminations be held very tightly together. The magnet shown in section Fig. 8 is representative of one of modern design, and is the type used on the line contactors of the controllers previously described. An explanation of this magnet will show how the various difficulties have been overcome to produce a satisfactory design.

A stationary core *B* and *B* is made in two parts of laminated steel with an air gap *D* provided between the two sections. The movable core *A* is also made of laminated steel and held tightly between heavy plates. To allow the movable core freedom to seat properly on the stationary core, it is connected to the contactor with a loose-fitting pin *F*. Since the surfaces of contact between the armature and field member are ground to a mirror-like finish, these surfaces always make good contact, which is an essential factor for quiet operation. To further add to the quietness of the magnet's operation, a closed copper loop (a shading coil) *C* is placed in the pole face of each end of the armature.

Quiet Operation of Contactors

When the current in the magnet coil is passing through zero value, the current induced in the shading coil will be at a maximum value. This current will maintain a flux in the core that overcomes the tendency the magnet has to open for an instant, until the current begins to build up in the reverse direction in the main coil. In this way any tendency that the armature may have to vibrate is eliminated and quiet operation is obtained.

It has been general practice to place the shading coil in the pole face of the magnet. In this location any heating of the shading coil is more readily transmitted to the magnet coil and under severe conditions this heating is more likely to injure the coil's insulation than when in the armature. As shown in Fig. 4, the contactors are not mounted directly on the armature, as is done in many direct-current magnets, but are placed on extensions from either side of the armature. On the three-pole contactors all three poles are located on one side of the magnet. These contactors are equipped with blowout coils to assist in breaking the arc and keep the burning of the contact tips to a minimum. What burning there is on the contacts, occurs on the tips, and since on closing, contact is first made on the tips and then rolls to the normal surface at the heel, a good contact is insured when the switch is closed.

To make the blowout coil more effective and prolong the contactor's life, an arc splitter is used. Figs. 9 and 10 show the action of the arc splitter as applied to a direct-current contactor, and for an alternating-current type this action will be practically the same. Without the splitter the arc tends to rise, as shown in Fig. 9, where with the arc splitter Fig. 10 the arc is stretched to the breaking point while it is within the magnetic field of the blowout coil. The splitter also has a considerable cooling effect on the arc and this helps to interrupt the circuit with a minimum of burning of the contacts.

Magnets for alternating-current work are made both single-phase and polyphase type. For controller contactors they are usually of the single-phase type although in some cases they are of the polyphase design. Polyphase brake magnets are probably more commonly used than single-phase magnets. In this case it does not involve any serious complications in the contact

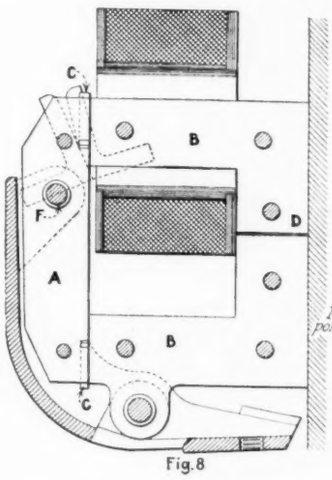
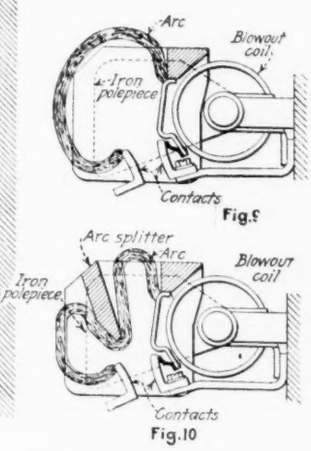


Fig. 8 — Diagram of alternating-current magnet contactor



Figs. 9 and 10 — Show how arc is broken at contactor tips

circuit. On controllers, the magnets are usually of the dry type, where on brake application the magnet is frequently immersed in oil. There are, however, elevator controllers built that use oil-immersed magnets. One of the chief objects sought in this wide variation in practice has been magnets that would operate quietly and to keep down maintenance expense.

Reforestation in Watersheds

Reforestation is becoming an important factor in water-power development and will probably become more so as the advantages become better appreciated. In the Northern Adirondacks, The Northern New York Utilities, Inc., has planted 4,000,000 trees on its watersheds and expects by 1930 to have 10,000,000 planted. This planting has been done on the watersheds of the Black, Beaver and Oswegatche Rivers. About 70 per cent of the trees are Norway spruce, 20 per cent pine and 10 per cent other species.

Reforestation protects the watersheds from erosion during heavy rains, prevents the springs from drying up at their sources, regulates the flow of streams by insuring a more even runoff and helps to reduce floods to a minimum. It will produce a revenue from otherwise non-productive land and will restore animal and fish life and improve the scenic beauty of the country.

Auxiliary Heater Increases Capacity of Existing Boilers

By STANISLAS BOLITZ

A NOVEL device designed to increase the steam-raising capacity of existing boilers has been patented by a Russian engineer, Prof. Wassily Perlowsky. The results obtained with this device in a series of tests performed at the Technische Hochschule Charlottenburg, Berlin, Germany, and its successful operation in practical service for eleven months thereafter, lend considerable interest to this invention. Pro-

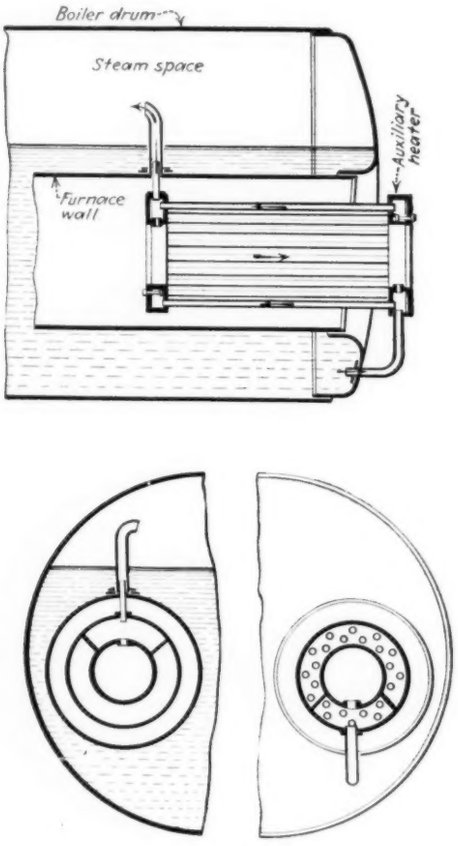


Fig. 1—Auxiliary heater installed in internally fired boiler

fessor Josse, director of the mechanical laboratory at the abovementioned school, reports:

1. A 50 per cent increase in the capacity of an 860-sq.ft. Lancashire boiler equipped with the Perlowsky heater.

2. A 15 per cent increase in boiler efficiency.

3. A reduction, of the order of 25 to 30 per cent in the time necessary to bring the boiler up to pressure from cold.

4. Eleven months of service in practical operation, without attention, in the boiler plant of this school.

The Perlowsky device, which will be called, for lack of a better name, an auxiliary water-tube evaporating heater, or evaporator, can best be described as an extension to the boiler heating surface similar to the economizer, except that it is added to the hot end of the boiler instead of the cold, for the purpose of facilitating a more rapid evaporation rate. It consists of a number of straight steel tubes of relatively small diameter in boiler practice—about 1½ in. outside diameter—connected between two headers of rectangular cross-section. The headers are divided into compartments by means of water-tight partitions or baffles, so as to group the tubes in series-parallel arrangement.

Position of the Heater

In adapting the heater to an existing boiler, it is placed in the hottest part of the furnace, as near as possible to the actual flame. The intake to the heater is connected to the boiler below the water level, and the outlet is carried up into the steam space above the higher limit of this level. The high temperature of the furnace and the large amount of heating surface per unit volume provided by the small tubes, give a very rapid circulation and a correspondingly high rate of evaporation. The inventor claims that, when the boiler reaches normal pressure, the heater delivers superheated steam if it has been correctly placed. In the Berlin tests, however, the two heaters used were installed too far from the actual flame, and the steam leaving the heaters was reported to be dry and saturated.

Freedom from Scale Formation

At first sight a certain amount of trouble might be expected from scale formation in such a device. Yet this is not borne out by the evidence of the Berlin tests. In fact, experience shows that the heater is less exposed to scaling than the rest of the boiler. If this is correct, the explanation undoubtedly lies in the rapid circulation secured.

Special Type of Bolt Fastenings

One of the points claimed by Professor Perlowsky in his patents is the novel method of fastening provided for the header cover, the purpose of which is to facilitate the removal of the covers for cleaning of the tubes. One of the principal troubles encountered in the early models of the heater was burning or corrosion of the bolts holding the covers by the furnace gases, so that, after a few weeks of service, it became practically impossible to open the heater.

The outstanding feature of the new design will be made clear by reference to Fig. 2. The header covers are drilled to a diameter larger than that of the bolt stem *a*, and the bolt head *b* bears on its inner face a deep circular groove corresponding with the annular clearance around the bolt stem, so that water or steam

can circulate in the thickness of the bolt head and keep it cooled below the corrosion temperature. A tongue-and-groove seat centers the cover correctly. The cover bolts pass through lugs cast on the inside of the headers. The steel nuts are replaced by pieces of copper plate *c*, each of these being drilled and tapped to receive four bolts. These pieces are themselves held in position inside the headers by means of small capscrews. The cover bolts may also screw into copper or brass reducing

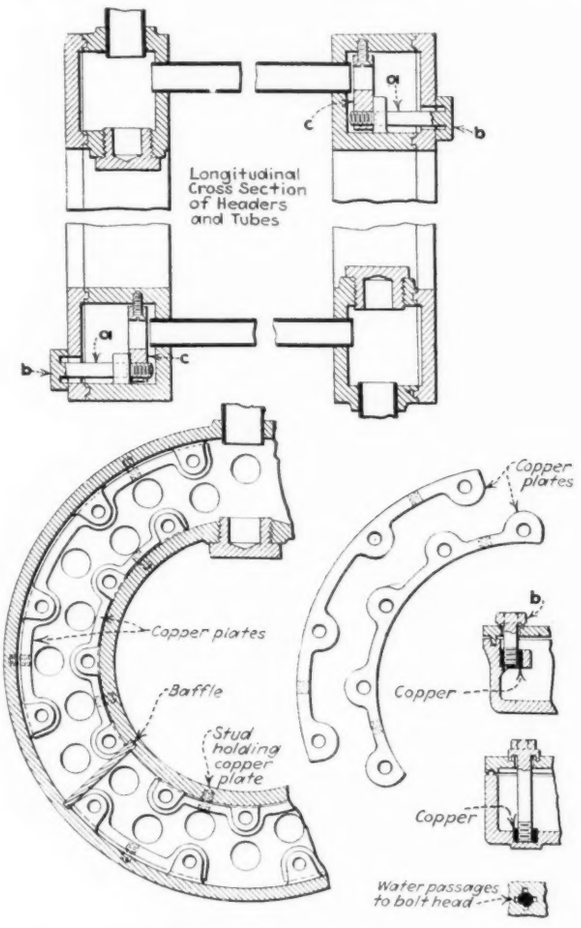


Fig. 2—Construction details of auxiliary heater

bushings themselves screwed into the bottom of the header.

All contact surfaces and screw threads being water-cooled, it is claimed that no freezing or corrosion of these surface can occur, and that the bolts can be readily removed.

HIGH-PRESSURE GERMAN TURBINE—According to a correspondent, the Association of German engineers has announced the construction of a line of steam turbines for pressures up to 200 atmospheres and up to 800 hp. capacity. Parts subjected to the high pressure are made of Siemens-Martin steel. The pressure stages are not horizontally divided, but are of ring construction, a separate steel ring being employed for each pressure stage. These are carefully ground to fit together and keep tight at a pressure of 200 atmospheres without any special packing. A high-pressure turbine of 4,000 hp. of this construction is at present undergoing trials in Germany, and is stated to have given excellent results.

How To Get an Engineering Job

BY H. M. FRIEND

THERE will probably be occasions in the life of every engineer when he is faced with the problem of getting another position. Much engineering work is of necessity temporary in nature; the construction job has been finished or work has become slack in the offices of the consulting engineer, and the forces are being reduced. There are also occasions when an engineer knows that he should leave his present company because he is not gaining more experience or because of limitations to his advancement in that organization. Conditions may be such that he would even do better to resign outright without any other job in sight. While this is a drastic step and is contrary to the advice of most men, my experience has convinced me that it is sometimes the best course to pursue.

No great alarm is felt by the seasoned engineer who has perhaps been through such conditions before, because he has grown to feel that this is a part of his engineering work, and he knows that he will follow it again and soon will design other projects, see other dams go up and other plants put in operation. The young engineer who has not yet gone through the mill may, however, be rather dismayed with the prospect of having to look for another job, and to him, especially, are these suggestions addressed, although they may also stimulate thought on the part of the old timer.

LEARN HOW TO SELL YOURSELF

Much thought should be given the matter of getting another job, and a definite course of action should be planned. It should be clearly understood that the problem is essentially a selling one, and as the engineer has probably had little experience in this line, he should make his plans especially well. He has himself to sell, and certain points in salesmanship can well be made use of. First learn your product; study yourself and arrive at a decision as to what job you are best fitted for, based on your experience, your likes and the probable market for such work.

Call on your friends and engineering acquaintances at their offices and get all the information possible about companies that are doing your line of work and where there may be openings. Give them your address so they can get in touch with you when they hear of openings.

In starting to look for a job there are certain preliminary things that you should do. There is the matter of writing letters. Be prepared to write many. Realize that you will never get a job directly through any letter; the best that you can accomplish is to get an interview where you can push it to a successful conclusion. Also realize that while a letter will not directly get you a job, it will lose you one if it is not properly prepared. The physical appearance of the letter is quite important. The neatest and easiest letter to read is the typewritten one, and remember that you are writing to busy executives who have no time to decipher poorly penned letters. All your letters, therefore, should be typed. Prepare a number of copies of your record. For this you may use carbon copies as long as they are clearly legible. This record should contain your address and telephone number, age, where born, married or single, religion, condition of your health, what college attended, degree and year obtained, professional societies, and any technical papers you have written.

Your experience should be listed briefly under the companies you have worked for, giving the period on each job, but not the salary received.

It is a good plan to have your photograph taken and a number of prints made and attach one to your record. A photograph gives an idea of your personality which the record cannot alone show.

Having obtained an interview with an official who has the power to give a job, go right after it. Remember the fundamental principles of making a sale; attract favorable attention, arouse interest, create desire and induce decision. Outline clearly the kind of job you want, rather than deal in generalities, and present your qualifications and experience for this job in an honest straightforward, sincere way. Be brief; remember the executive is a busy man. It is desirable to carry a personal file with you containing your record, letters from past employers, stating that your work has been satisfactory, or about things of especial value that you have done on those jobs, and any articles for publication, that you have written. You can now produce evidence at the interview that you have done important work, without requiring the exchange of letters with your references.

Locate in Some Large Center

If you live in a small town or in an out-of-the-way part of the country, when you are looking for a position you had better pack up and move to one of the big cities, preferably New York, and be prepared to stay there for several months if necessary. Many companies advertise in New York for men through the morning newspapers, the engineering societies, or through local employment agencies and later send their representative there to interview the men who have written in.

One of the best places to go for an engineering job is to the Engineering Societies Employment Service, New York City, or their Chicago or San Francisco offices. This service is run by the combined engineering societies and can be made use of by their members. If you do not happen to be a member, you should join your engineering society at once. They have a highly trained and efficient service and publish a weekly bulletin to which you can subscribe and which you can have sent directly to your address. This bulletin contains a list with description of the positions that are open, and you may send them a letter for any that interest you. They also publish a bulletin of men available with a brief description of their experience, but not their names. This is circulated among employers. Companies in need of men often send a representative to this building for interviews, and it is well to keep in touch with this office for any such possibilities.

Get Some Advice on Advertising

There are several commercial engineerng employment agencies in New York City that specialize in engineering positions, and it would be well to have a talk with them and to file an application blank which you should follow up with frequent visits.

In several of the engineering magazines and the New York morning newspapers there are help wanted columns, and you should keep in touch with them, though the chances of getting a job are smaller here than in the other ways mentioned. You can insert an advertisement in these same publications. Here is an advertising problem and for results get the help of an advertising man.

There are two general types of jobs to go after—one where you know an opening exists and the other where you think your services should be of value, but do not know of any definite opening. The first type is much the easier to tackle, and the greater part of your efforts should be directed in that direction. The second type is much harder to land, but it has been done before, so go at it with a punch. It is necessary to get a good line on exactly the kind of work the company does and the name of the proper executive to see. Present your qualifications and experience and outline to him the kind of job you want in his organization. If you have considerable trouble in getting him to say that he will take you on and you feel sure that you wish to be with that company, then tell him that you will work for him without pay for a month and that you feel sure that by that time he will pay you the salary you expect, which you should then name. If you are taken on this way, the chances are largely in favor of your staying; for in the first place you would not be taken on unless they thought you would be satisfactory, and the fact that you are so determined to get into this particular company stands greatly in your favor.

Put a Good Price on Your Services

In regard to the salary to ask for when you are applying for a job, put a good figure on your services even though you know that the job will not pay that much. An eminent consulting engineer who is noted for his good judgment in selecting his men, recently told the writer that when a young engineer applied to him for a job and placed a low price on his services, he at once thought less of the man than if he had named a high figure. He also stated that it was a different proposition if he offered to work for nothing for a trial. Incidentally, this engineer got his start in engineering by going into the office of the president of a concern and asking for a job, and when he was turned down he offered to work for nothing. This made such an impression that the president decided to try him out and called in the superintendent and gave instructions to hire him at nothing per week. They kept him on this salary for some time, never suggesting to pay him, till finally the president called him into his office and said that he wanted to send him to Cuba in charge of a construction job. The young engineer said that he wanted $100 a week and wanted it to begin from the time that he started with the company; and he got it.

In this work of hunting for a job the most important thing of all is to keep up your spirits and faith in yourself. When you have gone to many places with no success, keep up a stiff upper lip and do not lose your punch, but firmly believe that the next place you try will give you the opening you are looking for and the opportunity to put your best into your work.

If It Were as Convenient to measure oxygen as CO_2 in flue gas, the former would generally be preferable for boiler-furnace control. It is much less affected by the kind of fuel used. Air contains 20.6 per cent of oxygen. If pure carbon is burned with 100 per cent excess air, half of this oxygen is turned to CO_2 and the flue-gas analysis shows 10.3 per cent oxygen and 10.3 per cent CO_2. If hydrogen is present (still with 100 per cent excess air), the CO_2 is reduced considerably, but with little effect on the oxygen.

Power, Machines and Prosperity

AMERICA is prosperous. In fact, this prosperity has reached a point where some people are beginning to worry about it, just as they formerly worried about poverty and privation. The deadly parallel is drawn with ancient Rome—great prosperity, then disintegration.

Such comparisons are less valid than they may appear at first glance. The prosperity of Rome (far less than ours, by the way) was based largely on the exploitation of conquered nations. In an unmechanized world the average citizen could not possibly produce more than enough for a very modest existence. Hence real "prosperity" was obtainable only by the exploitation of the efforts of others. The few could have only as the many went without. With no known means of obtaining high production per worker, no man could be well fed, well clothed, well housed and provided with even the simplest luxuries except as he was carried—figuratively speaking—on the backs of oppressed workers in his own or foreign lands. In short, prosperity and justice were not and could not be on speaking terms before the advent of power and the machinery of transportation and production.

Our prosperity is founded not on the poverty of oppressed masses, but on high production per worker, or more precisely on high production per consumer, which is the true economic barometer. This in turn rests on power, the mechanization of industry and upon intelligent co-operation between management and labor.

The growing realization of these truths by the average American citizen augurs well for the continuance and improvement of our national well being during 1927 and the years to come.

Doing the Obvious

THE John Fritz Medal was recently presented to Elmer A. Sperry for his many inventions that have been marked contributions to the progress of the art of engineering. In responding to the presentation address, Mr. Sperry said that he never considered that he had done anything extraordinary. He merely analyzed the problem with care and then developed what seemed to be the simple and obvious solution. The mere fact that Mr. Sperry was able to provide this obvious solution marks his as a master mind. Many could neither secure sufficient grasp of the problem nor carry the analysis far enough to understand how it might be solved.

A lengthy sermon might be written on "doing the obvious." The first requisite is a calm survey of the problem. Then hard concentrated clear thinking in analyzing all its sides and aspects. One cannot depend on hunches or guesses. If this analysis is carried far enough, it will generally indicate the root of the problem, and when this is clearly conceived, ways and means to solve it will appear to any active mind. The trouble with most people is that they are mentally lazy. They do not readily take up the difficult task of hard continuous thinking on one subject. Their method of "doing the obvious" is often to leave the problem to somebody else, and therein they miss the pleasure and stimulus that result from real creative thinking.

Much is heard of the need of greater research if America is to maintain its industrial leadership. Research does not necessarily mean elaborate laboratories and extensive tests. Just as important progress may result from careful analyses of various problems which may be made in the quiet of an office or of a home. It is true that these new ideas may need to be tried experimentally in the shops, but this can follow once the obvious solution of the problem has been found.

This well-merited recognition of Mr. Sperry's splendid work, which he considered simply as "doing the obvious," should spur many others to more serious concentration on the particular problems before them. If Americans as a class can acquire this habit of clear thinking and analysis and then doing the thing this obviously points to, one has little fear for the continued success of our industries.

This Evolution Is Beyond Dispute

WHATEVER views one may hold on the much-debated subject of organic evolution, there can be no disputing the fact of mechanical evolution as applied to the power plant. A year is enough to show it. No one who made many plant visits last winter and is now making similar tours, can fail to note the change. The dreams of last year—many of them—have become the realities of today. Last year's novelties, the dreams of the year before, are now commonplaces. And innumerable improvements of the last ten years are penetrating steadily into the whole mass of plants, large and small, as capacities are increased and obsolete equipment is sent to the junk man.

Automatic combustion control installed in new central stations is now taken almost as a matter of course. It is perhaps even more significant that many industrial plants are adopting this method of reducing the losses due to human fallibility. An interesting outgrowth of experience with automatic control in boiler rooms is its increasing application to manufacturing processes.

It is not long since the steam accumulator, although a reality in Europe, was a dream in America. Some thought it an idle dream. Then came paper-mill applications, first in Canada and later in the United States. Now it is beginning to find its way into gas works and textile plants. Before long the accumulator promises to join the ranks of the commonplace. Welding is com-

ing in with a rush. The short space of six months has been sufficient to show a notable growth in its power-plant applications. Four or five years ago the average engineers had never heard of the air preheater. Most of those who had, thought of it as more or less of a "pipe dream." Now the air heater is so commonly used as to excite little comment.

Ingenious heat-recovery hook-ups of processes with bled steam, exhaust steam and circulating water, have ceased to be rarities. The day has about arrived when heat circuits will be handled with the same freedom and understanding as characterizes the handling of electrical circuits. What has been possible on paper is becoming the every-day application.

Discussing refractory troubles a few years ago, an engineer said, "Why not surround the fire with a tent of water tubes and cut out the refractories?" It sounded foolish, but today it is being done. Boiler design is in a state of flux that may lead us almost anywhere inside of another ten years. Pulverized fuel has been known for decades, but the period of its general recognition started only three or four years ago. Today the installations cover the country.

These are but a few examples; many more could be given. But they are enough to suggest the evolution or revolution now in full swing in the power plant.

The Cost an Important Deciding Factor

WHETHER a resistance starter or an auto-transformer type should be used to start squirrel-cage induction motors, when a starting device is required, has been the subject of much discussion. For a long time sentiment was much in favor of the auto-transformer, but this is changing as the characteristics of the two types are becoming better understood generally. The fact that, for the motor to develop a given starting torque, it requires a higher current from the line for the resistance-type starter, has been held as a handicap against this type of equipment.

An analysis of the factors influencing the problem will show that it is not so much a question of how much current is taken from the system as how quickly this is done. A load of two hundred amperes, if built up slowly so as to allow all parts of the system to become adjusted to the new load, may cause less disturbance than a load of one-half this value suddenly applied. Methods of controlling the starting current so that it will not cause a sudden demand on the system are more readily available with the resistance type than with the auto-transformer.

After the motor starts and the starting current decreases, the voltage at the motor terminals increases automatically with a resistance-type starter, where with the auto-transformer the voltage remains constant. This makes a much smoother transition from the starting to the running voltage with the former than with the latter. With some types of resistance starters the voltage is gradually built up to full value without any sudden changes. In some cases considerable stress has been laid on the effects of the current peak obtained when the motor is disconnected from the auto-transformer and connected to full voltage. This, however, is in general not so objectionable as some of the tests might indicate, as it is of very short duration.

A resistance type of starter is a means of energy dissipation where the auto-transformer is a voltage changing device, consequently the efficiency of the latter is higher than the former. This cannot be a serious objection to the resistance type unless starts are made frequently, in which case other factors also come into the problem, such as the size of the equipment to dissipate the heat developed in the starting device, and this comes back to a question of cost.

Many other arguments can be made for and against each type of starting equipment, but none of them under the average conditions can be considered as a deciding factor except the cost of installation and operation. There are special cases where this may not be true, but these are the exception and not the rule. Both types are in general use and are giving satisfaction, which is one of the best proofs of adequacy. There are some systems where the starting-current restrictions may be so stringent as to eliminate the resistance type, but where this is not a factor the cost of the equipment should be an important deciding factor.

A Good Investment

LACK of proper information on our rivers has been a handicap to an intelligent program for their development for power and other purposes. It is not a question of making one development on a river system, but one of utilizing the river as a whole for a co-ordinated program of improvement to attain the most economical development. In many cases this becomes a complicated problem, involving information on precipitation, available flow, flood and low-water periods, storage facilities, flood control, dam and power-house sites, navigation and other interests, all of which must be included in the picture if a correct solution of the problem is to be made.

There is only one agency that is in a position to do this work and that is the federal government, as it has control over all navigable rivers and, secondly, it would be practically impossible to have the states agree on a co-ordinated program of river survey, proof of which is not lacking in many of the disputes between states over water-power rights on a number of our river systems. Therefore the appropriation of over seven million dollars, included in the River and Harbor Bill which is about to become law, for an engineering examination of all navigable rivers and their tributaries upon which power development appears to be feasible, is a step in the right direction.

One of the difficulties that the Federal Water Power Commission has labored under when granting licenses for power developments, is the lack of information that the proposed engineering examination of our rivers will supply. What the government engineers have been doing in surveying the Tennessee River is a good example of what is required on many others. On account of the limited funds that have been available for this work, progress has been slow. With the proposed appropriation available, it will be possible to adopt a program that in a few years will make available information of great economic value in the development of our river systems, which have been characterized as one of our greatest natural resources. A great deal of work has been done by the United States Engineers Corps, Geological Survey, Weather Bureau, state and other agencies, but it requires some body with the authority and means to co-ordinate this work and fill in the missing links, and the proposal to intrust this work to the Geological Survey is well made.

Ideas From Practical Men

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Locating Cause of Voltage Failure on Alternator

At our plant there is a voltage regulator on a 300-kw. generator driven by a steam turbine. It is the practice to change the reversing switches on this regulator every twelve hours in order to make the wear on the relay contacts as uniform as possible and to discourage the tendency to form a cavity on the positive relay point when the current travels in one direction too long.

Some weeks ago, on going on duty one morning, I changed these switches and immediately the field of the alternator went dead and the voltage to zero. I took the regulator out of service and cut enough resistance out of the exciter field rheostat to raise the alternator's voltage to normal, and used hand regulation while hunting for the trouble. All switches in the regulator were examined to see that they were making good contact, and were found all right. All binding posts in the circuit were inspected for loose connections, and none were found. The direct-current and alternating-current relay magnets were tested for grounds and open circuits, and found to be clear.

The next step was to check up on the adjustments of the bearings, pivots, levers, etc., of the regulator. Everything was in good adjustment with the exception of a slight amount of wear (possibly 0.02 in.) on the main contact points. The proper adjustments were made and the regulator put back into service without any trouble. It was thought that the regulator trouble was over. However, two days later the voltage on the alternator went dead again. Knowing that the regulator was all right, I turned my attention to other connections on the switchboard. After searching for some time, I found one of the nuts loose on the direct-current ammeter binding posts, which allowed the field circuit to become open. After the nut had been tightened, the regulator was put into service and has since given no trouble.

JOHN R. WILSON.

Dayton, Tenn.

Rebuilding Old Generators

One of our good friends half across the world asked for our advice and help. He had several old generators that were of "voting age." Mechanically, the generators and wheels were far too good to scrap, and the cost of new machines plus the transportation and erection costs was prohibitive.

The revolving fields were of substantial construction, but the punchings and windings were giving trouble. The windings were straight copper bars driven in pairs through semi-closed slots and connected at the ends with a fearful array of curved copper straps. A winding of this design is hard to install without damaging the insulation while driving the bars through the punchings, and is doubly hard to repair.

To add to these troubles the clamping flanges gripped the punchings below the bottom of the armature slots and there were no end fingers to support the punchings between the bars. End fingers were unknown when the machines were designed, and there was no room for them in the maze of end connections. The unsupported ends of the punchings gradually crystallized and broke off because of vibration, and the loose piece usually nicked the insulation on a conductor as it worked out.

After going carefully into the situation, we decided to take down the cores, cut out the closed slots to a standard open slot and rewind the machines with up-to-date winding.

We planned to replace a half-inch of punchings on each end of the cores with steel plates, these plates to have rectangular notches cut in their inner edges cor-

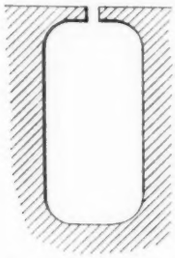


Fig. 1—Semi-closed slot

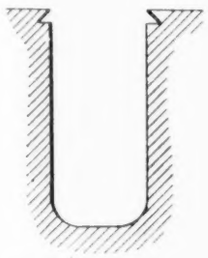


Fig. 2—Open-type slot

responding to the armature slots. The projection thus formed would make excellent end fingers to support the punchings between the coils.

Enough new punchings were made for one complete machine. This would give a set of the old punchings to work on and would shorten the time the machines were out of service. The waterwheels were also overhauled, bearings rebabbitted, etc., as the electrical changes were made. How to handle the work in the field was the real problem. The labor was typical coolies, so everything had to be planned for this class of help.

The old slots were of a shape similar to that shown in Fig. 1, and the new slots were made similar to Fig. 2. Ten small standard foot-power punches were purchased, and these were fitted with dies and indexing attachments so they would cut one slot at a time. Spare dies were furnished and also a holder, so that dies could be ground as they became dull.

We wondered how the native labor would take to the foot punches, but the erecting engineer understood human nature and solved the problem satisfactorily. He paid the punch operators a little more wages than the others and made considerable fuss over them. Punch work was, therefore, a very desirable job—a job that had to be diligently worked for and worked at. A punch operator was "a big dog with a brass collar"

with a bunch of men always "boning" for his job.

The next problem was cleaning and enameling the punchings. The machines had been assembled with tissue paper inserted between the punchings. This paper had rusted fast to the iron and defied wire scratch brushes or any cheap method of cleaning. In the meantime the erecting engineer had built an enameling machine out of odds and ends plus some new material. The old paper-coated punchings were dipped in kerosene and allowed to drain. They were then passed through the oven section of the enameling machine, which worked satisfactorily. The oil-soaked paper burned quickly, leaving a light ash that could be quickly and easily wiped off.

The cleaned punchings were then enameled and were ready for the next machine. Once the job was under way, the assembly of a core and the changes in the punchings for the next machine were carried on together. The cores were assembled with the new end fingers in the usual manner, using small screw-jacks and "old men" to press the punchings solidly together. This worked well, as did the winding, and was in accordance with present-day practice. The rebuilt units went back into service practically new machines with many years of service ahead of them.

N. L. Rea,
Contract Service Department,
Schenectady, N. Y. General Electric Company.

Making the Oiler's Job a Safe One

In most power plants the oiler has an important duty to perform. It is dangerous work in some plants, and in addition much oil is wasted. This job is frequently given over to a boy or the type of man that can be obtained at the lowest possible wages, with the result that hardly a day passes without the press recording one or more fatal accidents at this work. To the plant engineer, who in many cases is the only person who really understands the dangers of exposed setscrews and keyheads, fast running pulleys and belts and exposed gearing, must be accorded some of the blame and responsibility for these accidents.

Some engineers, I fear, although knowing the risks the oiler takes, allow matters to slide, or maybe the oiling is not directly under their charge and they do not feel disposed to interfere. Should an accident occur, they at once realize that something must be done and they get busy. But if these happenings were to be recorded upon their licenses, a different attitude would prevail and they would make every effort to eliminate the dangers and thus prevent many accidents.

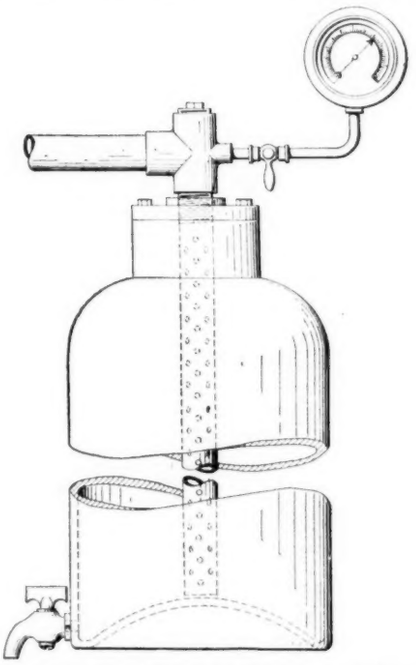
It was my experience when a boy to witness two accidents, both of which could have been prevented, and although many oilers have come under my charge since that time, the memory of those early happenings has been always before me and has been a factor in the removal of many danger spots about the plant. Often a slight alteration has changed a risky job into a safe one, and instead of using a ladder resting against a fast-running shaft, the oiling is done from the floor above without risk to anyone.

In the purchase of machines the oiling arrangements should receive more than passing attention. Many times I have called for alterations by the plant builders who have usually been quite willing to adopt my suggestion, not only in altering lubricators and oil-holes, but also in replacing exposed setscrews and the covering of dangerous key-heads. I am convinced that the engineer who desires to overcome the cause of these accidents will find the plant manufacturer ready and willing to help. Much can also be done by giving due warning to the oilers, pointing out the dangers of loose and ragged clothing and by arranging as far as possible for the oiling to be done when the machinery is stopped. It will also help considerably if the engineer will assume the responsibility for making the necessary alterations to the danger spots. If an engineer is handicapped by his employer, he should in his own interests, put all his cards on the table and let the employer take the responsibility, so that whatever happens he is not to blame, and his record will thus remain clean. F. P. Terry.

Belfast, Ireland.

Cleaning the Inner Surface of Injection and Starting Air Bottles

The bottles used for storing the injection and starting air for Diesel engines frequently become coated on their inner surfaces. Although these bottles are blown down periodically, this removes the moisture only, and the slime that has accumulated on the inner surface remains. The following describes a method we used to clean these with steam.



Connection for cleaning air bottles with steam

A section of 2-in. gas pipe was drilled with $\frac{1}{16}$-in. diameter holes spaced about two inches apart. The plate holding the usual connections was removed, and a duplicate of it was made to take the pipe. Connections were then made for the steam supply and a pressure gage, as shown in the illustration. When the connections were completed, steam was admitted until the steam gage registered about 30 lb. pressure. The blow-down cock was then opened and the steam supply adjusted to keep the pressure at 30 lb. This pressure was maintained for about four minutes. This treatment effectively cleaned out all the dirt and slime from the inner surfaces, and I have no hesitation in recommending it to anyone with similar problems.

Shefford, England. W. E. Warner.

Comments from Readers

Help the Other Fellow by Telling Him Your Experiences

Occasionally, when we read articles in the technical papers, we recall some past experience of a similar nature, and through recording these experiences give other engineers the advantage of being prepared should they meet with similar difficulties. Some years ago I was called to Canada on a trouble job where the steam plant was run as an auxiliary to a water plant, and it had suddenly become impossible to get better than 22 in. of vacuum on any one of the turbines. It was the month of January, and at this season of the year the temperature of the circulating water is low, and consequently the operating vacuum should be high. After the usual explanation that the shaft packing on the turbines had always given trouble, we started one turbine and began the search for leaks in the expansion joint, vacuum pump, stuffing-box glands, gaskets on the condensate lines, etc., without avail. We then decided to fill the whole steam space with water and see if that would show up any leaks.

We shut the throttle on the turbine and steam-driven circulating pump at nearly the same time, and the vacuum went down almost instantly, so we concluded we were short on circulating water, but the trouble did not seem to be from that source, as the engineer explained they never had any water trouble. Anyhow, I was not satisfied till I had taken off a handhole and looked at the condenser tubes. When we put the cover back again, one of the nuts was missing, and it was finally found under the circulating pump in a pool of water. When I reached for it, I noticed the water was ice cold and seemed to be running. Upon examination we found that the pump housing was cracked, which allowed the pump to draw in air on the suction side, and consequently operate at only partial capacity. When the housing had been welded and the pump put back into service, the vacuum went up to 28.7 in. and stayed there at practically all loads.

I knew of a plant in North Dakota where the circulating pump was set for low-water pumping, and the vertical driving motor was in a penthouse about 30 ft. higher, or above the high-water line. In winter it was always a safe bet that one of the guide bearings would either come loose or the grease become so cold that it would not lubricate and the bearing would run hot. It took a long time to convince the manager that the bearings should be bronze instead of babbitt, and lubricated with force or screw cups instead of gravity-feed grease slots.

The engineer's job is a much more agreeable one where the plant is properly heated in winter, but some designing engineers seem to think that when a boiler is placed in a room, no other provision for heating is necessary, when in reality a modern boiler room is usually the coldest place to be found around the plant.

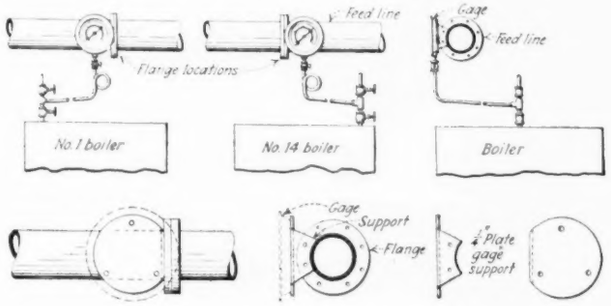
Chicago, Ill. CARL WILDEY.

A Novel Way of Keeping Gages from Freezing

In the Nov. 16, 1926, issue C. W. Stevens discusses methods of preventing gages from freezing in cold weather. I am reminded of an installation of gages that was rather unique. These gages were in a blast-furnace gas-fired boiler house containing fourteen exposed boilers covered only by a roof, so that when winter came, everything that contained water froze.

The water tender spent most of his time on the upper platforms of the boilers, and as he was responsible for the water conditions, it was decided to put the steam gages on top of the boilers where he could readily see them.

The firemen had master gages to guide them, but as much of the firing was automatic there was little need for the individual gages. When the gages had been



Method of mounting gages on the feed line flanges

mounted on the front of the boiler, they invariably froze in winter, particularly the ½-in. lines leading from the boiler drums.

It happened that the feed-water line ran along the front of the boilers about three feet above the edge of the boilers. In seeking a location for the gages, it was decided to mount them on the flanges of the feed-water line, and allow the gage line to slope gradually down to the boiler drum.

Plates were made so that the gages could be fastened to the flanges as shown in the illustration. The back of the plate rested against the flange, so that considerable contact was made between the plates and flanges. A little of the covering had to be removed from the flanges to mount the gages.

The feed-water temperature carried was about 210 deg. F., and the conduction of heat from the water to the Bourdon coil in the gage and the loop in the pipe was sufficient to keep them fairly warm. At the same time the water and condensation in the line leading to the gage flowed back to the boiler, so that the gage lines were always warm.

With this arrangement, for the last two winters, during which temperatures as low as 10 deg. below zero were encountered, every gage functioned continuously without failure. Prior to this the gages had to be

drained and left idle through cold spells. Even when the boilers were off the line and cold, no attention had to be paid to these gages as the feed line supplied sufficient heat to keep them warm and draining the gage lines back to the boiler kept them free from water. No alcohol or anti-freeze mixture was necessary.

Cleveland, Ohio. L. G. JONES.

The Gasification of Bituminous Coal

The report on the Coal Processing Session at the recent A.S.M.E. meeting has been very instructive to me inasmuch as we in this country are especially interested in the carbonization of peat. Mr. Wiertz, the director of our Bureau of Fuel Economy, has investigated the matter as to its commercial feasibility and reached the conclusion that successful operation is not at all certain, although many similar plants have been in operation in Germany. Obviously, the complete gasification of the peat is the solution of the problem, but unfortunately, a large amount of money is invested in the artificial waterways of the peat district to obtain cheap means of transport of this voluminous fuel.

I consider the gasification of bituminous coal the most practical and efficient way of handling this fuel and wonder when a suitable gas producer for this kind of fuel will be put on the market. It should be possible to gasify all high-volatile coking coals. To do this the coal in the producer has to be agitated from time to time, and the green fuel should be fed according to the principle of the underfeed stoker, so that the volatiles must pass through the incandescent part of the fuel bed in order to free the gas from tar.

In this connection I propose to build an invertible producer so that it will be possible to turn the fuel bed entirely upside down. The incandescent zone then rests on top and the green fuel may be fed gradually in order to make the removal of the tar more perfect. The producer is slowly turned around, consequently the fuel bed is kept in constant agitation to get rid of the ashes and prevent coking together of the fuel. Of course this involves departures from the normal design, but the cost of such a producer will not be absolutely prohibitive.

If a central gas plant is built, the working radius of the system is relatively small. However, it is possible to tie a number of gas plants into a loop system, as a good gas producer can easily be made suitable for automatic operation, perhaps easier than a steam boiler or a hydro station. H. WIELAND LOS.

Enschede, Holland.

Why Is the Vacuum Low?

In the Nov. 16, 1926, issue A. W. Napier cites a case of low vacuum and desires information as to the cause for it. Since he has made a thorough search for air leaks and his condenser is clean, also has fairly low discharge temperature averaging 122 deg. and has ample cooling surface, there would seem to be only two possible causes for the low vacuum. The air pump may be defective as suggested by J. Kunson in the Nov. 30 issue or the steam may be short-circuiting in the condenser.

The increase in vacuum from 13 in. at 900 kw. to 19 in. at 700 kw. indicates that his air pump is not equal to the duty of handling the increased air and non-condensible vapors at the higher load, except at increased pressure. But the fact that the condensate temperatures are high, points to trouble outside the air pump. There appears to be a discrepancy in the readings submitted. At 13 in. of vacuum the condensate temperature given is 160 deg. F., which is 12 deg. below the steam temperature given in Marks & Davis tables. At 15 in. of vacuum the condensate is 190 deg., or 10 deg. hotter than the steam table reading, when it should be several degrees cooler. Possibly he has given hotwell readings rather than the actual temperatures of the condensate leaving the condenser, otherwise his thermometer and vacuum gages need checking up. Four of the load readings show 750 kw., and the steam inlet pressure for the same load varies from 95 lb. at 5 o'clock to 70 lb. at 6 o'clock. At 700-kw. load the discharge temperature given is higher than at 900 kw. This does not seem reasonable. Assuming that the readings of the condensate temperatures are not over 15 deg. out of the way, it would appear that only a part of the cooling surface is active, due to short-circuiting.

At one time I was in a plant where 28 in. of vacuum could be carried in winter only by keeping the discharge temperature of the cooling water below 60 deg. Theoretically, it could have been carried well above 80 deg. and the superintendent of power suggested using less cooling water and raising the discharge to 82 deg. in order that the water could be used in a scouring process that called for warm water. When we tried it, however, we lost the vacuum completely, even though the change was made gradually, closing down on a large valve at the rate of half a turn a minute.

The air pump functioned perfectly, and upon inspecting the condenser, we found that the baffle that was used to distribute the steam flow toward the ends of the condenser was out of place, allowing the steam to short-circuit or to follow directly toward the air-pump connection instead of passing over the total tube surface. I am wondering how Mr. Napier's plant operates when starting up Monday morning, when the water in the spray pond is necessarily cooler than usual. Does it produce a better vacuum for a short time till the temperature rises? In my experiences with defective air pumps I have noticed that the condensate temperature does not rise much when the vacuum drops three or more inches owing to a defective air pump as long as the cooling surface is ample and enough cooling water is available. The steam flow, of course, will increase, and condensation is at a higher temperature, but the cooling effect of the lower tubes results in low condensate temperature even at reduced vacuum.

Springfield, Mass. A. F. SHEEHAN.

It occurred to me that some simple computations showing what conditions should be, might be of help to Mr. Napier in locating the cause of the low vacuum.

Assuming the turbine to be in fair condition, we may put the steam rate 20 lb. per kw.-hr. With a load of 750 kw. this would give a total steam flow of 15,000 lb. per hour passing to the condenser. In surface condenser work it is general practice to allow for the extraction of 1,000 B.t.u. per pound of steam exhausted. Assuming a steam rate of 20 lb. the amount of circulating water required would be $\frac{750 \times 20 \times 1{,}000}{26 \times 8\frac{1}{3} \times 60} =$ 1,154 gal. per min. As the circulating pump is rated at 3,600 gal. per min., there should be no shortage of

circulating water, unless the resistance through the sprays reduces the flow below this point. The cooling surface is given as 1,300 tubes ¾ in. in diameter, hence the area of one pass would be $\frac{1,300 \times 0.3318}{2} = 215.67$ sq.in. The amount of water circulated through the condenser is $\frac{1,154}{7.5} = 153.8$ cu.ft. per min., which gives a velocity of $\frac{153.8 \times 144}{215.67} = 102.7$ ft. per min., or $\frac{102.7}{60} = 1.7$ ft. per sec. For best results the velocity should be around 6 ft. per second. As the heat transfer at 6 ft. per sec. is 500 B.t.u. per sq.ft. of cooling surface per hour per degree difference in temperature and as the heat transfer varies as the square root of the velocity, the heat transfer in this case would be $\frac{\sqrt{1.7}}{\sqrt{6}} \times 500 = 265$ B.t.u. Then the mean temperature difference is $\frac{15,000 \times 1,000}{4,000 \times 265} = 14.2$ deg., which would give a temperature in the condenser of approximately 127 deg. Referring to the steam tables, this temperature corresponds to a vacuum of 25.5 in. As the readings given by Mr. Napier show a vacuum of only 15 in., I am inclined to believe he has a bad air leak or that the vacuum pump is at fault.

Bridgeport, Conn. H. I. CREED.

Why Short-Flame Travel Reduces Furnace Volumes

The article by J. G. Coutant in the Dec. 28, 1926, issue on "Why Short-Flame Travel Reduces Furnace Volumes," indirectly emphasizes in a dramatic way how extremely limited is definite knowledge on the subject of pulverized-fuel combustion. There are about two standard arrangements, one with vertical long-flame travel and the other (of more rapid, if more recent real development) with horizontal short-flame travel in which results can be forecast with fair precision. Any departure from these arrangements, as matters now stand, introduces an experimental element. Indeed, it is often surprising how even small departures, often forced by circumstances, will greatly affect the results. This does not mean that these two particular arrangements are the best that can be devised for various conditions or even for any given condition, but that to date they have been the two on which most thought has been expended.

Realizing the inherent advantage of the short-flame type of burner—that is, a burner in which practically all air for combustion is introduced at the burner—and realizing also the inherent structural and space economy of vertical or semi-vertical firing with the bent-tube type of boiler, the writer has been closely engaged in the attempt to apply short-flame combustion in a nearly vertical position. Immediate results were disappointing. Matters did not work out at all as anticipated. It looked at one time as though vertical firing and long flame were in some mysterious partnership. But after numerous changes and trials, none of which, fortunately, was very expensive, the problem is practically solved. This means a good deal, not only to the one plant, but to other existing boiler plants where the configuration and geography are such that neither long-flame vertical firing nor short-flame horizontal firing can be worked out satisfactorily except at considerable cost. Under date of March 9, 1926, page 386, *Power* published an interesting illustrated comparison of vertical long-flame firing and horizontal short-flame firing. The article stated that vertical firing necessitated jet velocities nearly 50 per cent greater than horizontal firing. This is true only as relates to vertical long-flame firing. Though there are numerous cases where vertical firing has been employed with all the air admitted at the burner, the velocities, mixing, etc., have, in general been such that B.t.u. liberation rates and flame lengths have more nearly approached "vertical long-flame conditions" than short-flame conditions as classified by Mr. Coutant. However, the writer is satisfied from his own experience that vertical firing and short flame are perfectly compatible and form a useful combination.

To the eleven combustion factors given by Mr. Coutant I would add at least five more, namely: Furnace draft, fineness of pulverization, volatile content, velocity of entrance, and mixing action of sound vibration.

The effect of furnace draft (in relation to entering velocities) on the shape of the flame in the case of the vertical short-flame installation with which I am intimately acquainted is profound. In one case at 200 per cent of rating it affects the efficiency nearly one per cent by giving the proper curvature to the flame, or, as some would say, "lifting the flame so it slightly bends back on itself." Here is a case where increase of draft from 0.02 to 0.07 in. of water measurably increases efficiency by giving more complete combustion and by actually reducing flue-gas temperature.

Fineness of pulverization, volatile content and velocity of entrance need no explanation, as their omission was certainly a mere oversight by Mr. Coutant.

As to the effect of sound on the combustion of coal, the writer believes his feeble efforts in this direction somewhat off the beaten path. But about all he can say with certainty just now is that in at least one commercial installation sound waves do have a visible effect on combustion under certain conditions. Just how much accelerating action such waves would have in the case of an installation designed to secure the optimum of such effect remains to be seen. But when so many engineers are thrashing about with such evident fervor to increase combustion rates, the possibilities in this direction would seem to deserve passing attention. And one may turn, as the writer has, with renewed interest to such antiquated laboratory playthings as the sensitive flame, the singing flame, Kundt's experiment in vibrating solid particles, etc.

Another interesting feature of Mr. J. W. Mellois' chart (reproduced in Mr. Coutant's article) is the easy quantitative explanation it offers for the relatively limited temperatures obtained in firing natural gas. It also gives quantitative figures on why the hydrogen flame is the hottest.

Finally, the writer wishes to observe that the hour is at hand when certain over-enthusiastic pulverizer manufacturers who boldly claim, "There is nothing to burner design, all we have to do with our machine is to stick a pipe in the furnace," are going to be laughed out of countenance. Even the prospective customer who looks a little and thinks a little is rapidly learning otherwise. Such experience travels fast and will inevitably operate to put pulverized-coal applications on a sounder basis. GUY B. RANDALL.

Dayton, Ohio.

A new slant on things observed in and out of the power plant

What Happens and Why?

A Few Facts About Heat Insulation

AIR is a very poor conductor of heat, and yet if one were to go out on a cold day with an oiled paper bag over each hand, and tied at the wrist, his hands would get cold. Getting cold

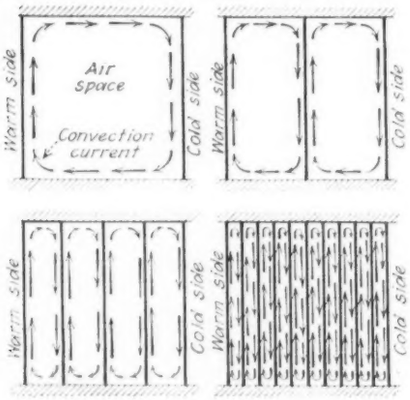


Fig. 1—As the air pockets are made smaller and more numerous, the transfer of heat by convection becomes more difficult

would mean that a lot of heat was passing from the hands through the surrounding air and the bag to the outer cold air. This and other experiments show that the statement "air is a poor conductor of heat," while perfectly true, must be interpreted with care.

Heat can be transmitted by other methods than by conduction; radiation and convection must also be considered. The former is unimportant at low temperatures, but convection is of great importance in the case of any fluid; that is, any gas or liquid. Air is a gas. When it comes in contact with a hot body, it becomes heated and lighter, moving away to make room for new cold air coming up. The hot air moves on until it comes in contact with a colder object, whereupon it gives up some of its heat. This cycle is convection, and it is this which makes the hand cold in the paper bag. If the air could be kept absolutely still, the bag of air would make the warmest kind of a glove.

Imagine the paper bag packed with loose wool around the hand. The mixture of air and wool is now a better heat conductor than the air was alone. Most solids conduct heat better than gases. However, it is evident that the conduction of heat through the wool must be very slow, as it has to traverse long thin fibers. For practical purposes the actual *conduction* of heat by the wool fibers can be forgotten, as can that through the air.

But the addition of the wool enormously decreases the flow of heat from the hand to the outer air, and it does this simply because it keeps the air to some extent from moving. There are thousands of little air pockets. In each of these convection can still go on, but on a very limited scale. Convection in one pocket carries the heat from one side to the other. Then it must be transmitted to the next pocket, where convection again carries it across. Evidently, such a series of hurdles is a great bar to heat transmission.

This and other experiments show clearly that the heat-insulating capacity of air is largely wasted when the air spaces are large and convection is permitted to take place freely.

It has frequently occurred that engineers have specified pipe covering a size larger than the pipe, with collars between to maintain a large air space.

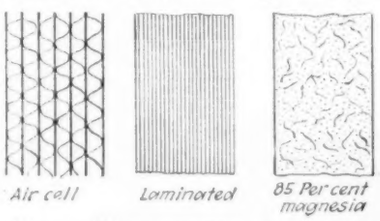


Fig. 2—Three common types of heat insulation

The actual result of this procedure is increased heat loss. More money is paid for the larger size insulation. While the air gap does, it is true, add another resistance to the flow of heat, it is small, and more than counterbalanced by the additional surface of the heat insulation. The more surface the greater is the opportunity for heat to escape. That, incidentally, is the reason why large thicknesses of pipe covering do not pay so well on small pipes as on large ones. Adding an inch to the thickness of covering on a 2-in. pipe results in a greater percentage increase in the outer surface than when an inch of thickness is added on a 10-in. pipe. For the same reason it costs more per square foot of pipe surface.

The same advantage of small air spaces over large ones is seen in the case of commercial pipe covering. Air-cell or other pipe coverings in which the air spaces are large have the lowest efficiencies. The highest efficiencies are shown by the coverings made up of a great number of thin laminations with air traps between, or of light fluffy powders, such as "magnesia."

"Eighty-five per cent magnesia" takes its name from the fact that it contains approximately 85 per cent of carbonate of magnesia in the form of microscopic crystals, and 15 per cent of medium-long-fiber asbestos. The asbestos is not added to increase the heat-insulating qualities, but merely to hold the magnesia together.

The magnesia itself is a sort of unmeltable snow. Snow, as is well known, has a high insulating value where the temperature is low enough to keep it from melting or packing. Under the microscope each crystal of snow is seen to be feathered, and of very open construction. As a result, a layer of newly fallen snow is mostly small air pockets entrapped between the crystals. This is easily proved by comparing the weight of a cubic foot of light snow with that of a cubic foot of water. Powdered carbonate of magnesia is also extremely light, and this lightness is due, just as is the case with snow, to the fact that it is composed of feathery crystals which do not pack tightly, but entrap great quantities of air in small pockets. It is worth repeating that the heat-insulating quality does not reside in the crystals themselves, but in the air they entrap.

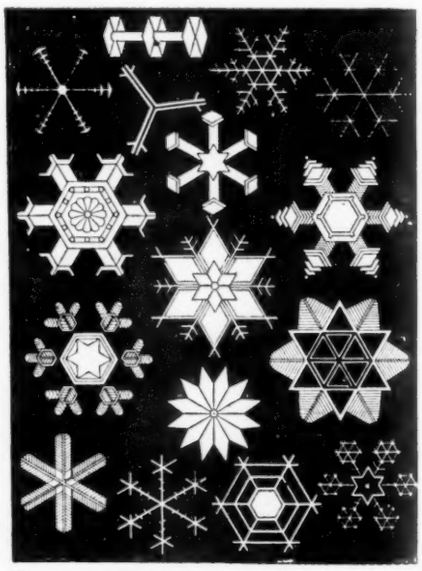


Fig. 3—Typical snowflake crystals (magnified) reproduced from Croft's "Practical Heat." These show why light snow, like magnesia, is a good heat insulator

If it were possible to compress a mass of carbonate of magnesia into a solid heavy block under a hydraulic press most of the heat-insulating quality would disappear. In the same way the heat transmission through a solid block of asbestos rock is far greater than that through an equal volume of asbestos wool formed by breaking up and carding the same asbestos.

Improvement in Oil Burners*

By ERNEST H. PEABODY
President Peabody Engineering Corporation

ONE of the contributing causes of waste of boiler oil is the necessity of making adjustments of individual burners, as is commonly the case with steam atomizers and some mechanical burners. If the fireman has to regulate individually a large number of burners at frequent intervals, he generally

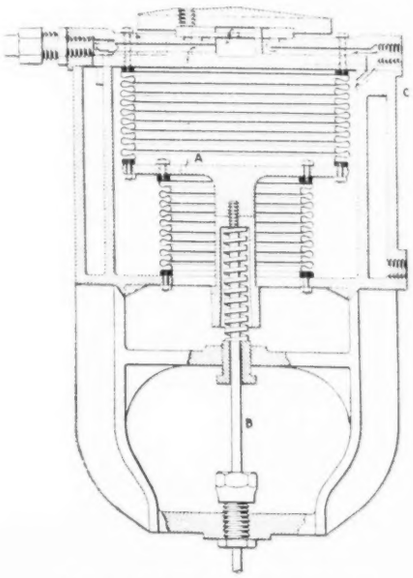


Fig. 1—Viscosity regulator for boiler oil

works down to as near the minimum of regulating none as he possibly can, with consequent loss in economy. Centralized control is just as important in an oil-burning installation as is the one-man control of the air brakes on a fast freight.

The wide-range return-line system lends itself admirably to the idea of putting the control of the fires in one place, where proper instruments for observing operating conditions may also be installed.

Controlling Viscosity

Heating the oil in order to reduce its viscosity to the desired degree is a matter of importance in all installations of mechanical atomizers. Heretofore, it has been necessary to make a viscosity test of the oil to determine the proper temperature to which it should be heated. This temperature is usually maintained in operation by hand regulation. If the oil changes in character, for any reason, the proper temperature is likely to change also, and this may occur without the operator being aware of it. The whole matter has recently been greatly simplified by the development of an automatic viscosity regulator.

After the oil has been raised in temperature in the heater and while it is being pumped under pressure to the burner, a small sample is diverted and continually passed through a device, Fig. 1, which is sensitive to viscosity, wherein a drop in pressure occurs. The greater the viscosity the greater will be the reduction in pressure and vice versa. In the body of the instrument and exposed to the two oil pressures on opposite sides there is a plate or disk *A* which is attached to the stem *B* of a valve located in the steam supply line to the heater.

This disk is connected with two sylphons of different diameters, which leave the disk and attached valve stem free to move up and down, thus partly opening or closing the steam valve and

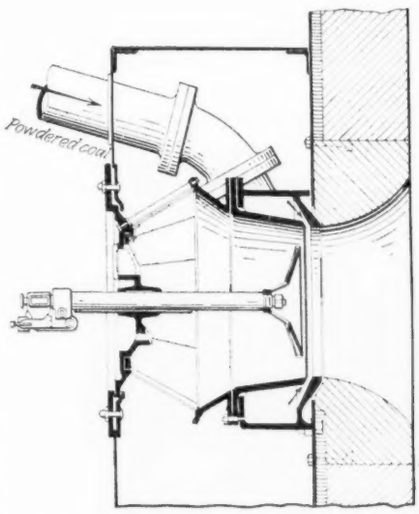


Fig. 2—Cross-section of oil-and-coal burner

varying the amount of steam used for heating the oil. The diameters of the sylphons are so designed as to make the reduced annular surface on the lower side of the disk, compared to the full area on the upper side, exactly proportionate to the drop in pressure that occurs when the viscosity of the oil is at exactly the required degree for proper atomizing. This is usually fixed at 180 Saybolt sec.

Pressure Actuated

If, then, the smaller or reduced area of the disk is exposed to the higher or initial pressure of the oil, and the larger or full area is exposed to the lower pressures due to passing the oil through the viscosity diaphragm shown at the top of the instrument, the disk and valve will be placed in equilibrium and will remain so as long as the viscosity remains at the desired point. If, however, the oil for any reason becomes more viscous, the pressure on top of the disk will be reduced, throwing the machine out of balance and causing the valve to open and admit more steam to the heater. This causes a reduction in viscosity, and a return to the balanced condition as soon as the viscosity again returns to normal. Should the oil become too hot or the oil from any cause unnecessarily fluid, an unbalanced pressure condition is again set up, but this time in the reverse direction, and the steam valve will begin to close, again returning to the balanced condition when the viscosity becomes normal.

Viscosity Held Uniform

Thus, regardless of the quality or the quantity of the oil passing through the heater, the viscosity regulator controls and modifies its temperature, so that the desired viscosity will always be maintained. This at once provides an automatic temperature control and makes laboratory determinations of viscosity entirely unnecessary. The instrument itself is continuously making a test, in addition to its function as a temperature regulator.

Developments in Burners

The mechanical burner, unlike the steam atomizer, requires all the air for combustion to be admitted around the oil spray, and for this purpose a so-

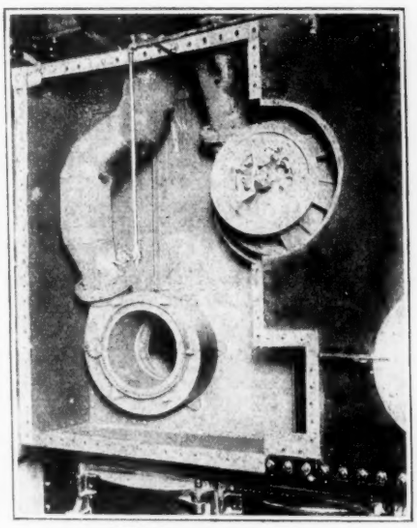


Fig. 3—Combination burner at Sherman Creek station

called air register is used. This advice has a very important bearing on the effective operation of the burner, and matters of proportion, area and air currents have to be carefully worked out. The superiority of certain types over others is largely dependent on the design of the register.

There has recently been developed a new application of the mechanical atomizer which I think has a special significance in conserving fuel in the oil industry. This is a combined burner

*Abstract of paper presented before the American Petroleum Institute, Tulsa, Okla., Dec. 9, 1926.

for either oil or pulverized coal, or for oil and gas, and is shown in Figs. 2 and 3. The latest development is a combined burner for all three of these fuels. The use of still-coke in the pulverized form is beyond the experimental stage, and I expect to see oil, gas and coke commonly used as fuels for firing oil stills. A burner which, merely by the turning of a valve, can be changed over to utilize efficiently either or any of these fuels should have distinct operating advantages in this field as it has in that of the steam plant.

Three experimental burners to handle coal and oil have been developed. They have been in operation for the last 18 months at the Sherman Creek plant of the United Electric Light & Power Co., New York City, and have shown fine results. The slot through which is fed the finely pulverized coal suspended in air is clearly shown in Fig. 2.

The three-fuel combination has not yet been put into service. It is, however, merely a combination of the other two combinations.

Service—Alex Dow*

Long ago, when Sieur Joliet passed through the straits,
He saw no lights friendly and cheering;
No industry throve when Tonty and DeLuth
Established their camp in the clearing.
Then Cadillac came and a village sprang up
And the habitant followed the plow;
A city developed with factories and homes,
And then came our friend Alex Dow.

To render a service to man in his needs,
With skill and devotion unending,
To accomplish the task without ill will or strife
And never with friction contending;
To bring to the factory more power, more light,
And to achieve the strange combination
Of quite paradoxically serving the home
With heating and refrigeration.

The fields of Delray were attacked and subdued,
'Twas the work of no mere dilettante;
The sappers and miners have taken Detroit,
The air men are past Ypsilanti.
The battle of Trenton was long and severe,
In the country our outposts are standing;
Marysville's fallen, Port Huron succumbed,
And the fleet has arrived at French Landing.

Now I don't know a volt from a kilowatt-hour,
An ampere my noddle confuses,
Transformers and hydro-electric are terms
The expert may use if he chooses.
Should I meet an ohm as idly I roam,
I'll stop not to flirt or philander,
For what is the use with such things understood
By Alex, the great understander?

And then when it comes to the realms of finance,
Reserve, depreciation and taxes,
Clearing-house balance and budget and bonds,
It's then that my reason relaxes.
Refunding and amortization are things
That really affect me quite queerly,
And I find in the Edison latest report
That Alex explains them quite clearly.

Now some will descend to tricks that are vain,
Skullduggery and prestidigitation,
Hornswoggling the case with a mere mess of words,
Double-shuffling with mean obfuscation.
But Alex we know is above such deceit,
Such methods he passes up quickly
And never was guilty of bringing a blush
To the face of the chaste Mr. Ripley.

Now when in the fullness of time he has gone,
He will be no inactive immortal,
For when you're approaching St. Peter, you'll find
A button to press on the portal.
And I may be working in green pastures fair,
Where still waters feed a substation,
In the sight of a glorious city ablaze
With the lights from his last installation.

*Verses read by Granger Whitney on the occasion of the recent testimonial dinner to Mr. Dow.

Responsibility for Electric Power Lines' Effects

The employee of a consumer of electric power used at a pumphouse was electrocuted through a guy wire that had become charged at 2,300 volts. The court decided that the power company was liable. The guy wire had been attached to a pole about one foot above an uninsulated high-tension wire. The guy wire itself was uninsulated, and rotting of a post to which the lower end had been fastened resulted in the guy wire remaining loose. It had been pushed out of the way by those coming in contact with it without injury to any one until the man was electrocuted. The following is an abstract of the court's decision:

Mitchell, although manager of the consumer's farm, had no duties concerning the power line, and therefore cannot be said to have caused his own death through failure to remedy the condition of the guy wire.

The contract under which the power company furnished current to the consumer made the consumer responsible for the keeping in repair of the electrical equipment only on the pumphouse premises, not extending to the transmission line before it reached the pumphouse premises, although the line extended over the consumer's other premises. "The duty and the risk of the transmission is upon the company until it reaches the consumer for use at the delivery point."

The actual ownership of the line is a matter of little consequence, under the circumstances, "because to transmit such a deadly current of electricity over such carelessly constructed and unprotected wires is primary negligence on the part of the company." If the company was negligent, it can make no difference that the consumer was also negligent toward deceased, the consumer's employee, because joint wrongdoers are equally liable.—*Abstract by A. L. H. Street.*

Hazards of Using Non-Standard Flexible Cord

In an article in the *N. E. L. A. Bulletin*, Arthur P. Good, chairman, N. E. L. A. Wiring Committee, states that the electrical supply market is flooded with flexible cord which does not comply with the standards of the National Electrical Code. A great mass of this cord has no braid around each conductor, and the rubber insulation of each conductor is practically of no value, as it is something less than $\frac{1}{64}$ in. In addition to this, an inferior grade of rubber is used. As a result the entire assembly presents a distinct fire and personal injury hazard. This cord is used in many varieties of portable equipment where safety is sacrificed for appearance or space.

Numerous instances are coming to the attention of municipal and underwriters authorities where short circuits have occurred by the use of this cord, by it either accidentally coming in contact with the grounded surface or being stepped upon, the insulation being so flimsy that very little pressure breaks it and the copper wires come into contact, and as a result, a short-circuit occurs. If the circuit is overfused, the result may be a fire, or if part of the body is close to the point where the cord is damaged, a severe burn may result, and such personal injury has, in many cases, actually resulted.

Manufacturers Not To Blame

The manufacturers cannot be censored for putting this cord on the market. Credit should be given to them for being very reluctant to put it on the market and for constantly protesting against its continued use, but there is a demand for it, and so long as the demand continues it will be manufactured. Therefore, the best place to attack its usage is through the stores or organizations that manufacture or sell appliances using this cord. If the demand can be abolished, the manufacturers will be very happy to discontinue its manufacture.

A consistent and widespread refusal throughout this country to employ this type of cord will undoubtedly result in so discouraging the use of this hazardous material that manufacturers of lamps and other portable devices would be compelled to cease using it and adopt safe materials.

The Wiring Committee desires, therefore, to urge strongly that those in the commercial or inspection departments of member companies bring together in their communities the municipal or underwriters interests, with the managers or department heads of their stores selling electrical portable equipment, and lay this matter before them, urging their co-operation in bringing such pressure to bear as is necessary eventually to eliminate entirely this dangerous cord.

News in the Field of Power

California Boiler and Elevator Inspectors Meet

Caustic Embrittlement Forms Subject of Live Discussion—Welding of Air Tanks Also Receives Attention

ALL interests employing certified boiler or elevator inspectors in California were represented among the 110 delegates who registered for the sixth annual convention of the California Certified Boiler and Elevator Inspectors, which met in San Francisco Jan. 5-7. The meeting was presided over by Chairman A. J. Lamie, of the Ocean Accident & Guarantee Corp.

Progress that has been made toward the adoption in modified form of Section VIII of the A.S.M.E. Boiler Code to apply only to air-pressure tanks, was outlined by E. G. Sheibley, chief engineer of the California Industrial Accident Commission. He stated that the greatest obstacle has been the question of allowable unit stress in autogenously welded tanks. The American Welding Society has opposed strenuously the limited allowance made in Section VIII, paragraph U68 of the Boiler Code, whereas the majority of boiler inspectors and many other engineers favor the Code requirements. Although opposing factions are still about one thousand pounds apart on this point, Mr. Sheibley believes that an agreement will soon be reached which will be satisfactory to both sides and which will provide reasonable safety.

Elevator Selective Control

An address on "High-Speed Elevators," by L. W. Whitten, of the Otis Elevator Co., was particularly instructive and included a description of the push-button selective control now being used in many new office building installations.

"Corrosion, Its Causes and Prevention" was a paper presented by A. B. Burns, of the Dearborn Chemical Co., which proved of great interest. The author summed up the causes of embrittlement in steam boilers as concentration of caustic soda in the seams in the absence of much sulphate or carbonate, together with the existence of localized stresses in the seams. The removal of a large percentage of the sodium carbonate with the building up of a sodium sulphate-sodium carbonate ratio by the use of either sulphuric acid or aluminum or magnesium sulphates, has its disadvantages.

The acid treatment is not to be recommended unless installed under the advice and supervision of an expert in such matters and operated under supervision of a chemist or engineer who understands the danger of its use. The aluminum and magnesium-sulphate treatment is effective when used in connection with settling tanks and filters that remove the possibility of scale-forming ingredients in the boiler. These two chemicals are as dangerous, in Mr. Burns' opinion, if used in excess, as is acid, and should be employed only after a thorough checking of the amounts necessary by a chemist. Undecomposed sodium carbonate acts as an inhibitant, and if a plant should operate with a large percentage of makeup high in carbonates, the amount of hydroxide formed might be lower, since the introduction of fresh carbonates would tend to keep the carbonate-hydroxide ratio high and might in turn inhibit embrittlement.

Causes of Embrittlement

Results of the investigation were summarized as follows: (a) Embrittlement in boiler plate is caused by the combined action of stress and chemical attack. The stresses are inherent in the construction and operation of the boiler, while the chemical attack is caused by sodium hydroxide in the boiler water. (b) Certain methods of water treatment tend to convert some safe waters into the characteristic type of water which produces embrittlement. (c) The presence of sodium sulphate in the feed water and undecomposed sodium carbonate in the boiler water tends to retard the embrittling effect of carbonate waters, and if these are present in the proper proportions they will stop it entirely. (d) Methods for introducing sulphates in boiler waters have been worked out to the point of practical application.

The paper resulted in a lengthy discussion. A number of those present scouted the possibility of the caustic element in the water having anything to do with the causes of embrittlement described. Nevertheless, there were several who told of experiences in the southern section of the state which tended to confirm the conclusions drawn by the author.

Boiler Practice Developments

In a paper on "Installation of Power Boilers," R. L. Hemingway outlined the problems of the boiler inspector and showed that present boiler practice demands an inspector much better equipped with technical knowledge than has been required in the past.

"Steels" was the title of a paper dealing with the manufacture of steel, presented by Fred J. Wight. R. S. Twogood, in a paper entitled "Modern Developments in Boiler Practice," brought out the point that the operation of boilers at higher ratings and consequently higher furnace temperatures has made it undesirable to depend upon brick furnace walls as boiler supports. "It would seem good practice," he stated, "to support all brick-set boilers on cast-iron or steel columns, thereby reducing to a minimum the load on the furnace walls."

Reliability of fusion welds, particularly in the oil industry, was shown by James C. Bennett, in his paper on "Welding Practice." The author expressed the belief that as time passes all industries that avail themselves of the advantages offered by fusion welding will standardize on methods, first of periodic tests and second of inspection, both during the execution of the work and after completion.

John B. Waters, Jr., supervising engineer for the Independence Indemnity Co., Los Angeles, was elected chairman for the ensuing year. David Hunter, also of Los Angeles, was elected secretary-treasurer. Los Angeles was chosen as the meeting place for the next convention.

N.A.S.E. Name Stays, Report of Referendum Shows

Decisions by vote on the various proposals submitted for this year's referendum of the National Association of Stationary Engineers, the number of votes cast for and against, and by what margins the proposals were carried or lost, have been reported by the association's referendum committee.

Outstanding among the innovations turned down was the defeat of the proposal that the name of the organization be changed to the National Association of Power Engineers. Three-fifths of the total vote being necessary to carry a proposal, this change was lost by 12 votes, 1,386 ballots being cast for it, and 946 against. To change "Stationary" to "Operating" in the name of the body was defeated by 1,338, only 67 votes sustaining it.

Exhibition Clause Lost

A proposal to add a new paragraph to Section 10, Article XV of the constitution the following: The board of directors shall have complete charge of the mechanical exhibition at the national convention and have same conducted under the name and for the benefit of the National Association of Stationary Engineers. Any surplus derived from said exhibit after the legitimate expenses of the exhibit part of the convention has been paid, the balance shall be paid over to the national secretary and by him transmitted to the national treasurer to be used for the educational and propaganda work of the order—was lost by 134—for, 1,261; against 1,063.

Boulder Dam Project Is Hit in House—Minority Views

Representative Leatherwood, of Salt Lake City, Utah, has filed a minority report in the House of Representatives announcing his opposition to the enactment of the bill providing for the construction of the Boulder Dam on the Colorado River by the federal government, this being known as the Swing-Johnson bill. The report represents his individual views as a member of the Committee on Irrigation and Reclamation.

The measure, Mr. Leatherwood contends in his report, seeks to bestow special advantages on the State of California at the expense of her sister states and the public at large. "The plan of development proposed in the bill," he states, "is misrepresented as primarily a flood control and reclamation measure, whereas it is, in fact, primarily a gigantic government power project masquerading in the more appealing clothing of flood control and needed water for irrigation and domestic uses."

Representative Leatherwood argues in his report that the bill provides for "Government entrance into the power business, and puts the government directly into this great industry on a gigantic scale. The worthy objects of the bill," he states, "can be accomplished at a fraction of the proposed expenditure."

Hayden's Attack

Representative Carl Hayden, from Arizona, in his minority views against the proposed bill, claimed that the proposal if carried out would violate the law in that the right to appropriate water for irrigation, power and other beneficial uses shall, according to the Constitution and those of the states involved, be obtained from the state and not from the federal government.

1. Favorably reported in both houses at Washington, the minority leaders are making a last stand. The nine other points of Mr. Hayden are:

2. Only complete agreement between the United States and the seven Colorado Basin states, or else a Supreme Court decision, could bring about a valid apportionment of the water.

3. Arizona, after conceding to Nevada all the water that state can ever use, asks for an equal division with California of the remainder. In agreement with Nevada, Arizona asks the right to collect each year from any hydro-electric power produced by the federal government a sum equal to the taxes which would be paid if the same site were owned and developed by private enterprise.

4 and 5. In the absence of a treaty with Mexico for apportionment, the dam would benefit that country to the injury of Arizona and enable Mexico to produce cotton and farm products that would compete in American markets.

6. The bill, although appropriating $125,000,000, has not been recommended by the Director of the Budget.

7. The bill is falsely represented as a reclamation act, whereas in truth its primary purpose is to create a government hydro-electric plant.

8. Flood control, the need for which is universally acknowledged, is only an incident to the major purpose of the bill. Flood control could be secured for less than one-third the sum appropriated.

9. Los Angeles' water needs for domestic purposes can be better supplied from the Sierra Nevadas.

10. The bill is sure to result in protracted litigation. Arizona will fight it.

N.E.L.A. Enters Fight

An interpretation of the Swing-Johnson bill in "an effort to show wherein the measure provides the possibility of the government entering the power business on a large scale" has been prepared by the department of public information of the N.E.L.A. and issued to member company executives. "It would appear," this statement says, "that if the facts were generally known to the press and public, there would be a general opposition to the government undertaking this project in the face of the immediate pressing necessity for a smaller project for flood control and the protection of the Imperial Valley." The N.E.L.A.'s document calls Boulder Dam "the most ambitious experiment in government ownership and operation ever advanced for public acceptance," throws doubt on its engineering possibility in view of its great height—600 ft.—and the annual floods on the Colorado, doubts that the sum appropriated would prove sufficient, and calls "fantastic" the idea that this sum can be recouped by sales of electricity.

A.S.H.V.E. Committee Proposes Boiler Rating Method

For some time the matter of rating low-pressure heating boilers has been in a chaotic condition and has been unsatisfactory to engineers, architects, manufacturers and contractors throughout the country. This situation was noted by the United States Bureau of Mines and called to the attention of the American Society of Heating & Ventilating Engineers as a most disturbing condition in the industry.

The Bureau has suggested the appointment of a committee to study this condition from all angles, and has urged the society strongly to take up this matter in an effort to provide a satisfactory solution of the rating question, particularly as the repeated efforts of manufacturers and others have failed because of competitive conditions and trade jealousies, it has been pointed out.

H. P. Gant, chairman of the society's Committee on Research, responded to this appeal and appointed a Technical Advisory Committee with the following personnel: Alfred S. Kellogg, consulting engineer, Boston, chairman; Percy Nicholls, fuel engineer United States Bureau of Mines, Pittsburgh; L. E. Seeley, Sheffield Scientific School, Yale University, New Haven, Conn., and F. C. Houghten, director of the A.S.H.V.E. Research Laboratory, Pittsburgh.

From the results of this survey the committee will draft a report to be presented at the society's annual meeting in St. Louis, Jan. 26-28.

Long Beach Steam Unit No. 3 Begun by S. Calif. Edison

Work on the installation of the first 100,000-kw. unit of the new Long Beach steam plant No. 3 of the Southern California Edison Co. is to begin at once, according to an announcement just made by George Clinton Ward, vice-president in charge of operation and construction for the company.

Present plans call for the eventual installation of eight such units, which will bring the total capacity of the entire Long Beach steam plant to more than 937,500 kw. This first unit is to be ready for operation Feb. 1, 1928, and is to cost, together with necessary transmission and distribution equipment, approximately $7,000,000.

This new structure is to be placed immediately adjacent to the present steam plant, the first unit of which was built in 1912. It is to be of reinforced concrete construction, 250 ft. long by 230 ft. wide by 90 ft. high. As new units are added the structure is to be lengthened to a full 1,000 ft. To furnish a suitable foundation more than 7,500 piles averaging 40 ft. in length are to be driven. Inside of the turbine hall the turbine itself will rest upon a reinforced-concrete structure 32 ft. high.

Philo To Install 165,000-Kw. Turbo-Generator

The American Gas & Electric Co. announces the purchase for the Philo plant of the Ohio Power Co. of a steam generating unit with the extraordinary large rating of 165,000 kw. The installation of this unit, complete with boilers, housing, coal-handling apparatus and high-tension transformers, calls for an expenditure of approximately $17,000,000. With it the Philo plant will have a total capacity of 245,000 kw. The Philo plant is near the center of Ohio on the Muskingum River, on the western edge of the Ohio coal fields. The initial installation of 80,000 kw. was made two years ago. With the Windsor, Twin Branch, Cabin Creek, Kenova, Glen Lyn and Logan plants, it feeds one high-tension transmission system which extends from Michigan through Indiana, Ohio and West Virginia to southern Virginia and Tennessee on the south and the Ohio River on the east and is interconnected with Chicago, Toledo, Cleveland and Pittsburgh lines, making it rank among the largest interconnected power systems in the world.

Boiler Inspectors To Meet in Nashville

The National Board of Boiler and Pressure Vessel Inspectors has decided to hold its next annual meeting at Nashville, Tenn., during the second week of June. An attractive program is being arranged.

Efforts will be made at the next meeting of the Tennessee Legislature to have legislation adopted assuring the installation of boilers in such wise that the public safety shall not be menaced.

New York P.S.C. Attacks Stock Juggling by Utilities

To protect the investing public, the Public Service Commission, now the state division of the Department of Public Service, recommends in its annual report amendments to the law designed to prohibit manipulation of stock and screening of public-utility profits in the general funds of holding corporations by permitting the commission to investigate and make public all relationship between holding and utility companies.

The amendments generally are believed to strike at the telephone companies and their subsidiaries, primarily the American Telephone & Telegraph Co. and the New York Telephone Co., together with the Western Electric Co.

THE FOUR AMENDMENTS

1. That the Public Service Commission law be amended so as to permit inquiry into the costs and profits accruing to non-utilities from that branch of their business having to do with the furnishing of products or service to operating utilities for ultimate distribution to the consuming public.

2. That the statute be amended so as to define as holding companies those corporations which control operating utilities in this state not only by ownership of the majority of the stock, but also lease, or operating contract with the right of appointing managers and employees, and by control through voting trustees.

3. That the Public Service Commission law be amended to require holding companies, controlling operating utilities to make and file annual and periodical reports on forms to be prescribed by the Commission, including full details as to property, products or service, exchanged between controlled companies and the revenues and expenses relating thereto.

4. Giving jurisdiction and authority to the Public Service Commission to investigate the relationship between holding companies and operating utilities to the end that all the activities of the holding companies controlling operating companies in the state, including all contracts, agreements, etc., may be made a matter of public record.

From the frequent complaints alleging excessive charges for electricity by New York landlords in large apartment houses, the report says, there is immediate need for authority over apartment-house meters being given to the commission.

Paper Company Seeks Alaska Water Power

The International Paper Co., of New York, has applied to the Federal Power Commission for a preliminary permit for a power development on Ravillagigedo Island, Alaska. This application conflicts with those previously filed by William Randolph Hearst, Mark L. Requa, George T. Cameron, Thebo, Star & Anderton, and by the Alaska Pulp & Paper Company.

Apparently, the newspapers and the newsprint interests represented by the applications have concluded that conditions are particularly favorable on Revillagigedo Island for the manufacture of paper and pulp. Since the applicants first must secure a timber license from the Forest Service, the conflict will be settled before that agency rather than before the Federal Power Commission. The Power Commission probably would grant the power license to the interest holding the timber rights.

California Oregon To Build New Hydro Station

The California Oregon Power Co., a subsidiary of the Standard Gas & Electric Co., has started work on the construction of a new hydro-electric development on the north fork of the Rogue River in Oregon, according to an announcement by H. M. Byllesby & Co.

The new plant, which will have an initial capacity of 22,000 hp. and an ultimate capacity of 66,000 hp., will produce 130,000,000 kw.-hr. annually. The cost is estimated at $3,250,000. It will be constructed under the supervision of the Byllesby Engineering & Management Corp.

97 PER CENT LOAD FACTOR

Prospect No. 2, as the plant will be called, will be built on the Rogue River above the existing No. 1 development which has a capacity of about 6,300 hp. A diversion dam will be built about two miles above the power house site. There will be an open canal 6,600 ft. long, and a 3,160-ft. wood stave pipe line and 980-ft. penstock will carry the water from the forebay to the power house.

The plant will operate under a head of approximately 600 ft., and will be an extremely efficient development, as it is planned to operate it on a 97 per cent annual load factor. A step-up substation will be built at the power house and a high-tension transmission line will be extended 36 miles to connect with the company's system at Medford, Oregon.

It is expected that the initial installation will be completed by Oct. 1, 1927.

Indiana Engineering Society To Meet Soon

The Indiana Engineering Society will hold its forty-seventh annual meeting at the Lincoln Hotel, Indianapolis, Jan. 26 and 27. On the opening day E. W. McCullough, Indianapolis representative to the Society, will speak on the work of the American Engineering Council. Dean Dexter Kimball, president of the council, will discuss engineering participation in public affairs.

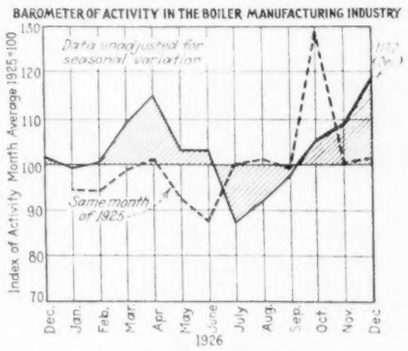
Boiler Industry Has Good Year in 1926

The year 1926 closed with the boiler manufacturing industry operating some 16 per cent above the operations reported for December, 1925, and 19.2 per cent above the average monthly activity for the year 1925.

A large part of the indicated increased activity during December, however, is due to the fact that November had two less working days than December. After correction is made for the number of working days, it is found that the actual December activity was only 0.3 per cent above that of November. Such is the picture of productive operations in the boiler manufacturing industry as indicated by the consumption of electrical energy by a large portion of the boiler manufacturing plants of the country.

The year just closed, taken as a whole, witnessed operations in the boiler manufacturing industry slightly above those of 1925. During the first half of the year operations were considerably above those of the same month of 1925, but from June to November were under those of the same month of 1925. November and December operations, however, were above those for the same month of the previous year.

There are many indications that 1927 will be a good year in the boiler manufacturing industry. The electric light and power industry expects to spend more money than ever to take care of the remarkable expansion of that industry and to cover obsolete equipment. The heavy construction industry expects another record year during 1927. Credit is easy to obtain, and the outlook for general business and industry is most encouraging.



"Power" barometer of activity in the boiler manufacturing field

The year 1927 should be as good for the boiler manufacturing industry as 1926, if not better.

Obituary

Oscar E. Bulkeley, superintendent of the electric light and water systems of Lansing, Mich., died at his home in that city Tuesday, Jan. 7.

Born in 1885 at Oneida, Ill., Mr. Bulkeley was graduated from Knox College, at Galesburg, Ill., with the class of 1905 as bachelor of science, being 20 years old at this time. In 1906 he went to Butte, Mont., wishing to gain practical experience in mining. He entered the mines of the Anaconda Copper Co., taking up a pick and shovel and going down into the copper workings. Before leaving he had attained the position of general purchasing agent.

In January, 1910, he entered the University of Illinois and was graduated there, in civil engineering, with the class of 1912. Immediately after grad-

uating from the university he took the position of assistant superintendent of the water department at Rockford, Ill.

After serving at Rockford three years, Mr. Bulkeley removed to the water works in Jackson. Early in 1918 he entered the service of the government in the erection of the large powder plant being built near Nashville, Tenn. In the fall he was placed in charge of the entire water-works system.

In January, 1920, he removed to Lansing, Mich., and became superintendent for the board of water and electric light commissioners, which position he held until his death.

Personal Mention

Thomas R. Allen was appointed Jan. 7 assistant works manager to direct all shipbuilding activities for the American Brown Boveri Electric Corporation.

Ottomar H. Henschel, plant engineer for the Federal Pressed Co., and former associate editor of *Power Plant Engineering* has established offices for the practice of consulting engineering at 50 Keefe Ave., Milwaukee, Wis. Mr. Henschel is specializing in the design, construction and operation of steam and electric power generating, distribution and utilization systems for industrial plants and commercial buildings.

Society Affairs

The A.S.M.E., Metropolitan Section, will hold a joint meeting with the New York Section of the A.I.E.E., Wednesday evening, Jan. 19 at the Public Service Auditorium, Newark, N. J., when "The Kearny Plant of the Public Service Electric & Gas Co." will be the topic of R. J. S. Pigott, consulting mechanical engineer, and W. R. Smith, managing electrical engineer. The East River station of the New York Edison Co. will also be the subject of a brief lecture by E. B. Ricketts and R. H. Tapscott.

The American Society for Steel Treating, Hartford Chapter, will hold a joint meeting with the A.S.M.E., at the Hartford Electric Light Auditorium the evening of Feb. 8, when M. F. Moore, professor at the University of Illinois, will speak on the fatigue of metals.

Business Notes

The Riley Power Equipment Co., merchant engineers, Milwaukee, Wis., have moved their offices from the Security Building to larger quarters at 49 Oneida Street.

The Brown Instrument Co., Philadelphia, has engaged C. E. McGregor, formerly of the Republic Flow Meters Co., to handle the new Brown electric flow meter in the Chicago territory.

Border Bowman, formerly of Staley & Bowman, of Columbus and Springfield, Ohio, and Albert F. Nathan, announce the partnership of Nathan & Bowman, with offices in the Singer Tower Bldg., 149 Broadway, New York City, where they will continue their practice as patent counsel and solicitors.

The Sheffler-Gross Co., sales engineers of heating and power plant equipment and temperature control apparatus, 205-11 Drexel Bldg., Philadelphia, have been appointed the Philadelphia representatives for the L. J. Wing Manufacturing Co., of New York City. This concern manufactures a line of forced-draft blowers, both motor driven and turbine driven, and also unit heaters of the suspended type.

The McClave-Brooks Co., manufacturing McClave combustion systems, announces that Alfred Lotz, formerly of the Underfeed Stoker Company of America, Jan. 17, assumed his duties as manager of the Chicago district territory with his office at 1510 Conway Bldg., Chicago, Ill. H. P. Grohn, formerly with the same company, will act as assistant manager to Mr. Lotz. The company also reports the removal of its Cleveland district office to Pittsburgh, Pa., with headquarters at 304 Oliver Bldg. H. E. Passmore is manager.

Coming Conventions

American Institute of Electrical Engineers. Winter convention at New York City, Feb. 7-10; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at St. Louis, Mo., Jan. 25-28; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

Chicago Power Show, at Chicago, Feb. 15-19. G. E. Pfisterer, managing director, 53 West Jackson Blvd., Chicago.

Engineering Institute of Canada. Richard John Durley, secretary, 176 Mansfield St., Montreal, Que. The forty-first annual general and general professional meeting will be held at Montreal on Thursday, Jan. 27, and will be adjourned to reconvene at Quebec City at the Chateau Frontenac Hotel Feb. 15, continuing on the two succeeding days.

Midwest Power Conference, at Chicago, Feb. 15-18. Sessions will be held in the Coliseum concurrently with the Chicago Power Show; G. E. Pfisterer, secretary.

National Association of Stationary Engineers—Annual convention at Los Angeles, Aug. 22-27.

National Association of Stationary Engineers. New England St tes convention at Portland, Me., June 17-18. Thomas H. Clark, president, Worcester, Mass.; Robert Johnson, secretary, 65 Charlotte St., Worcester, Mass.

National Board of Boiler and Pressure Vessel Inspectors. Annual meeting at Nashville, Tenn., during second week of June.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Annual convention at Atlantic City, week beginning June 6.

National Marine Engineers' Beneficial Association. Fifty-second annual convention at the Hotel Franklin Square, Washington, D. C., Feb. 14. Albert L. Jones, secretary-treasurer.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Jan. 10 1927
Pool 1	New York	$3.00@$3.50
Smokeless	Boston	2.46
Clearfield	Boston	2.25@ 2.70
Somerset	Boston	2.35@ 2.80
Kanawha	Columbus	1.75@ 2.00
Hocking	Columbus	1.75@ 2.00
Pittsburgh	Pittsburgh	2.00@ 2.25
Pittsburgh gas slack	Pittsburgh	1.60@ 1.70
Franklin, Ill.	Chicago	2.50@ 2.75
Central, Ill.	Chicago	2.00@ 2.25
Ind. 4th Vein	Chicago	2.25@ 2.50
West Ky.	Louisville	1.35@ 1.75
S. E. Ky.	Louisville	1.75@ 2.00
Big Seam	Birmingham	1.75@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1	New York	2.75@ 3.50
Buckwheat No. 1	Philadelphia	2.75@ 3.00
Birdseye	New York	1.35@ 2.00

FUEL OIL

New York—Jan. 13, light oil, tank-car lots; 28@34 deg. Baumé, 5¾c. per gal.; 36@40 deg., 6¼c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Jan. 4, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.05 per bbl.; 26@28 deg., $2.10 per bbl.; 28@30 deg., $2.15 per bbl.; 30@32 deg., $2.20 per bbl.; 32@36 deg., gas oil, 6¼c. per gal.; 38@40 deg., 7.37½c. per gal.

Pittsburgh—Jan. 5, f.o.b. local refinery; 30@34 deg., fuel oil, 6¼c. per gal.; 36@40 deg., fuel oil, 6¾c. per gal.

Philadelphia—Jan. 7, 27@30 deg., $2.52@$2.58 per bbl.; 13@19 deg., $1.725@$1.785 per bbl.

Cincinnati—Jan. 10, tank-car lots f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Jan. 10, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.27½ per bbl.; 26@30 deg., $1.35; 30@32 deg., $1.65.

Boston—Jan. 10, tank-car lots f.o.b. 12@14 deg. Baumé, 4.55c. per gal.; 28@32 deg., 5.85c. per gal.

Dallas—Jan. 1, f.o.b. local refinery, 26@30 deg., $1.80 per bbl.

Trade Catalogs

Boiler Room Practice for Sugar Mills—The Edge Moor Iron Co., Edge Moor, Delaware, has published and distributed a booklet of practical suggestions on better boiler-room practice for sugar mills, prepared by A. D. Flower, M.E.

High Temperature Cement — The General Refractories Co. has issued a booklet describing a new chrome-base high-temperature cement recently marketed as "Grefco" by the company.

Arc Welding Sets — The General Electric Co. in an illustrated bulletin describes constant-potential arc welding sets for any number of operators up to capacity, metallic or carbon electrode welding. The sets are designed to generate direct current at 60 volts at all ampere outputs to rated capacity. Standard sizes of these welding generators are 400, 500, 750, 1,000, and 1,500 amperes.

Copper Expansion Joints—Jos. Kopperman & Sons, 342-46 New St., Philadelphia, Pa., designers and manufacturers of "Kopp-Sure-Travel" copper expansion joints, have recently published their latest manual and catalog on copper expansion joints. This manual contains data and practical suggestions as to type of joints best suited to reduce pipe-line troubles to a minimum.

Flow Meters—The Brown Instrument Co. in a new catalog recently issued, the operation and advantages of the inductance-bridge principle in the application for flow meters is fully described and illustrated. The catalog opens with a concise introduction outlining the fundamentals of flow-meter design, principal uses of flow meters and benefits gained from such use. The various elements of the complete Brown Electric flow meter line are pictured and described.

New Plant Construction

Ala., Birmingham—Alabama Power Co., 600 North 18th St., awarded contract for redevelopment of the Upper Tallahassee plant on Tallapoosa River increasing height of dam from 36 to 57 ft., initial installation of two 25,000 hp. units with total ultimate of three units to Dixie Construction Co.

Ark., Prescott—Southern Ice & Utilities Co., Santa Fe Bldg., Dallas, is having plans prepared for the construction of an ice plant, 60 ton daily capacity, also storage house, 10,000 ton capacity. Machinery will include two compressors driven by natural gas engines.

Conn., Bridgeport—United Illuminating Co., 1115 Broad St., is having plans prepared for the construction of a power unit on East Main St. Estimated cost $200,000. Westcott & Mapes, 139 Orange St., New Haven, are engineers.

Conn., Stamford—City awarded contract for the construction of a sewage pumping station to Carabee & Porcia Bros., Mamaroneck, N. Y.

Fla., Jacksonville—G. A. Barry, West 5th St., Archt., will receive bids until Jan. 25th for the construction of a 5 story hospital and power plant at Third and St. Johns Sts. for St. Vincents Hospital. Estimated cost $1,000,000.

Ga., Atlanta—City, W. L. Smith, Gen. Mgr., plans waterworks improvements including coal and ash handling equipment, mechanical stokers, etc. Estimated cost $180,000. J. W. Ely, Atlanta Trust Bldg., is engineer.

Ill., Chicago—Armour & Co., U. S. Yards, will build a power house on Benson Ave. by day labor. Estimated cost $150,000. R. C. Clark, U. S. Yards, is architect.

Ill., Chicago—L. A. Albert, representing syndicate, 3318 Sheridan Rd. is having plans prepared for the construction of a cleaning and dyeing plant including cooling plant at 2600 Addison St. Estimated cost $1,000,000. Koenigsberg & Weisfeld, 155 North Clark St., are architects.

Ill., Chicago—A. S. Alschuler, 28 East Jackson Blvd., Archt., will receive bids about Jan. 15 for the construction of a 12 story hotel at Madison and Des Plaines Sts. for Harvey & Dammarell, 628 West Madison St. Estimated cost $750,000.

Ill., Chicago—A. S. Alschuler, 28 East Jackson Blvd., 136 West Lake St., Archt., will receive bids about Jan. 15 for the construction of a 17 story produce exchange and office building including steam heating system, elevators, etc. at Franklin and Washington Sts. for Chicago Mercantile Exchange, 136 West Lake St. Estimated cost $2,500,000.

Ill., Chicago—Physicians & Surgeons Institution, c/o L. Guenzel, 879 North State St., Archt., is having sketches made for the construction of a 23 story hospital at Maple and La Salle Sts. Estimated cost $6,000,000.

Ind., Bloomington—Showers Bros., manufacturers of furniture, is having plans prepared for the construction of a factory and a central power plant. Estimated cost $400,000. H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O., are architects and engineers.

Ia., Davenport—Kohrs Packing Co., 1343 West 2nd St., awarded general contract for the construction of a 100 x 100 ft. power plant on West 2nd St. to Priester Construction Co., Kahl Bldg.

Kan., Olathe—City is having plans prepared for waterworks improvements including dam, 40 ft. high and 700 ft. long, pumping equipment, etc. Estimated cost $50,000. E. T. Archer & Co., 609 New England Bldg., Kansas City, are engineers.

Ky., Louisville—Kentucky Hydro Electric Co., awarded contract for the construction of a hydro-electric plant at dam No. 7 on the Kentucky River to L. E. Meyers & Co., 53 West Jackson Blvd., Chicago, Ill.

La., Slidell—A. D. Canulette, Mayor and Bd. of Aldermen, will receive bids until Feb. 4 for waterworks improvements including reservoir, fire pump, service pump, tank on tower, etc., also sewage disposal plant, three pumping stations, etc. in connection with sewage system. J. W. Billingsley, Interstate Bank Bldg., New Orleans, is consulting engineer.

Me., West Enfield—Bangor Hydro Electric Co., E. M. Graham, 194 French St., will build a hydro-electric development, work to be done by day labor. Private plans.

Mich., Ann Arbor—Snell Realty Co., 1519 Dime Bank Bldg., Detroit, is having plans prepared for the construction of a 4 story hotel including steam heating boiler and equipment, elevators, etc. on Huron St. here. Estimated cost $500,000. L. Kamper, Kamper Bldg., Cass Ave., Detroit, is architect.

Miss., Starkville—Borden Milk Co., 350 Madison Ave., New York, N. Y., awarded contract for the construction of addition to cold storage plant, etc., here, to D. D. Thomas & Sons, 463 North Dunlop St., Memphis, Tenn. Estimated cost $40,000.

Mo., Kansas City—A. O. Thompson, c/o A. O. Thompson Lumber Co., 3100 East 18th St., awarded contract for the construction of an ice plant at 201 West 71st St. to Morley Bros. Construction Co., Dwight Bldg. Estimated cost $40,000.

Mo., St. Louis—Hadley-Dean Glass Co., 703 North 11th St., is having preliminary plans prepared for the construction of a 22 story office building including high speed elevators, etc. at 11th and Lucas Aves. Estimated cost $1,400,000. Architect not selected.

N. J., Trenton—Public Service Electric & Gas Co., Terminal Bldg., Newark, awarded contract for the construction of addition to power house on Chauncey St., here, to Public Service Production Co. Estimated cost $75,000.

N. Y., Brooklyn—Paerdergat Ice Corp., F. Vennola, Pres., 783 East 42nd St., is having plans prepared for the construction of addition to ice plant. Estimated cost $60,000. Burke & Olsen, 32 Court St., Brooklyn, are architects.

N. Y., New York—Bronx Hospital Association, S. Minskoff, Chn. of Bldg. Committee, 2382 Grand Concourse, will build an 8 story addition to hospital at 169th St. and Fulton Ave. Estimated cost $1,600,000. Jaros & Baum, 116 West 39th St., engineers. Work will be done by separate contracts under the supervision of L. A. Abramson, 46 West 46th St., Archt.

N. Y., New York—Queen Marie Hotel Corp., c/o G. F. Pelham, 570 7th Ave., Archt., having plans prepared for the construction of a 15 story hotel including steam heating system, elevators, etc., at 109 West 46th St. Estimated cost $2,000,000.

N. Y., New York—Recreation Terraces, G. McAneny, Chn., Ritz Towers, Broadway and 57th St., plans the construction of a playground building including steam heating system at Jacob Reiss Park and Mulberry St. Estimated cost $2,000,000. B. Goodhue, 2 West 47th St., is architect.

N. Y., New York—Roosevelt Hospital, 59th St. and 9th Ave., is having plans prepared for the construction of a 4 story addition to nurses' home including steam heating system, elevators, etc. Estimated cost $500,000. York & Sawyer, 100 East 42nd St., are architects.

N. Y., New York—State Hospital Comm., State Capitol, Albany, awarded contract for the construction of an 11 story psychiatric hospital and institute at 168th St. and Riverside Dr. here, to Guidone & Bottino, Inc., 52 Vanderbilt Ave., New York. Estimated cost $1,292,472.

O., Chagrin Falls—Bd. of Education, H. B. Pugsley, Clk., will receive bids until Feb. 7 for the construction of a central heating plant. A. M. Allen & Co., 7016 Euclid Ave., Cleveland, are architects and engineers.

O., Cincinnati—Dept. of Welfare, J. E. Harper, Dir., Ninth and Oak Sts., Columbus, is having plans prepared for the construction of a power house for Longview State Hospital for Insane. Estimated cost $50,000.

Okla., Chattanooga—City voted $18,000 bonds for waterworks improvements including triplex pump, mains, etc. Engineer not selected.

Okla., El Reno—City is having preliminary plans prepared for waterworks improvements including new wells, pumping equipment, 4 turbine well pumps, etc. Estimated cost $40,000. C. W. Fassett, is engineer.

Okla., Healdton—City plans an election Jan. 21 for waterworks improvements including deep wells, four deep well pumps and motors, etc. Estimated cost $65,000. C. Coon, is engineer.

Okla., Maud—City plans waterworks improvements including new well, deep well pump and motor etc. Estimated cost $17,000. Long & Co., Colcord Bldg., Oklahoma City, are engineers.

Okla., Sayre—City plans waterworks improvements including new wells, pump houses, etc. Estimated cost $60,000. Gantt Engineering Co., 1116 West Main St., Oklahoma City is engineer.

Okla., Sayre—Southwestern Light & Power Co., Braniff Bldg., Oklahoma City, plans the construction of a dam on Timber Creek here for power purposes. Estimated cost $141,000. E. R. Erusberger, Braniff Bldg., Oklahoma City, is engineer.

Okla., Tipton—City plans waterworks improvements including filtration plant, dam across Otter Creek, centrifugal pumps, etc. Estimated cost $45,000. Long & Co., Colcord Bldg., Oklahoma City, are engineers.

Oregon—California Oregon Power Co., subsidiary of the Standard Gas & Electric Co., 454 California St., San Francisco, has work under way on the construction of a hydro-electric development on the north fork of the Rogue River in Southern Oregon, plans include diversion dam, step-up substation, 980 ft. penstock, transmission line, etc. The plant will have an initial capacity of 22,000 hp., ultimate total capacity of 66,000 hp. Estimated cost approximately $3,250,000. Work will be done under the supervision of Byllesby Engineering & Management Corp., 231 South La Salle St., Chicago, Ill.

Pa., Chester—City had plans prepared and takes bids in Spring for a pumping station, etc. in connection with intercepting sewer and sewage disposal system. Barker & Wheeler, 36 State St., Albany, N. Y., are engineers.

Pa., Meyersville—Penn Public Service Corp., Johnstown, plans the construction of a power sub-station on Olinger St. here to furnish power to Meyersdale, Garrett, Salisbury and Grantville, Md., also to furnish power for traction lines from Meyersdale to Salisbury. Estimated cost $150,000.

S. C., Columbia—The Broad River Power Co., W. A. Bastow, Arcade Bldg., has acquired the plants of the Enoree Power Co., Blue Ridge Power Co. and the Melrose Power & Mfg. Co. and plans to expend $2,500,000 for extensions and improvements.

Tenn., Chattanooga—J. H. Street & Associates, Times Bldg., plans the construction of a cold storage and dry storage plant. Estimated cost $750,000.

Tex., Amarillo—A. Davidson, will soon award contract for the construction of a 15 story hotel including heating plant, refrigeration system, 5 elevators, etc. Estimated cost $2,000,000. Private plans.

Tex., Beaumont—Forrest & Associates, Crosby Hotel, will build a 12 story office building by day labor. Estimated cost $600,000. Tisdale, Stone & Pinson, Independent Bldg., Nashville, Tenn., are architects. Owner is taking bids for heating, refrigeration and circulating ice water systems, 4 high speed elevators, etc.

Tex., Brownwood—Morgan-Wade Utilities Corp., A. O. U. W. Bldg., Little Rock, Ark., has acquired the plant of the Crystal Ice Co., and is having surveys made for extensions and improvements to increase the capacity to 30 ton here. Estimated cost $40,000. Private plans. Machinery will be electrically operated.

Tex., Dallas—Southwestern Bell Telephone Co., Western Indemnity Bldg., had plans prepared for the construction of a telephone building including power plant on Alcord St. Estimated cost $5,000,000. Lan & Witchell, American Exchange Bank Bldg., are architects and engineers. I. R. Timlin, c/o owner is associate architect.

Tex., San Benito—W. Wood, First National Bank, Brownsville, has been granted permit for irrigation of 2,000 acres. Pumping equipment will be required.

Tex., San Antonio—Clarence Garrett Investment Co., et al, Maverick Bldg., awarded general contract for the construction of a 12 story hotel at Ave. E. and 4th St. to L. T. Wright & Co., 910 Builders Exchange Bldg. Estimated cost $800,000. Refrigeration, cooling and circulating ice water systems, elevators, etc. will be installed.

Tex., San Antonio—G. A. Duerler Mfg. Co., 218 West Commerce St., awarded contract for the construction of a cold storage plant on Herff St. to E. Oeffinger, Builders Exchange Bldg. Estimated cost including equipment $18,490.

Tex., Waco—Waco Development Co., A. Sanger, Pres., will receive bids after Jan. 20 for the construction of a 12 story office building including 4 elevators, etc. at Austin Ave. and Fourth St. Estimated cost $700,000. Milton W. Scott & Co., 412½ Franklin Ave., are architects.

Wash., Tumwater—City authorized the sale of two bond issues totaling $35,000 for waterworks improvements including reservoir, power house, pumping equipment, etc. W. J. Roberts, Tacoma, is engineer.

Wis., Fond du Lac—City, C. J. Fay, Clk., will receive bids about Feb. 1 for the construction of a sewage disposal plant including pumping equipment, etc. Alvord, Burdick & Howson, 8 South Dearborn St., Chicago, Ill., are engineers. W. G. Kirchoffer, 22 South Carroll, Madison, Wis., is consulting engineer.

Que., St. Alban—Portneuf Power Co., Portneuf, plans the construction of a power house and dam on the St. Anne de la Perade River near here. Estimated cost $1,500,000.

Mexico, Coahuila—Palao—National Lines of Mexico Coal Mines, c/o E. Gonzales Salas, Mgr., Mexico City, plans the construction of a power plant, also coke plant to furnish gases to heat boilers. Estimated cost $500,000.

Equipment Wanted

Ala., Birmingham—Alabama Power Co., 600 North 18th St., will open bids very soon for the major equipment for the Upper Tallahassee hydro-electric project.

Calif., Los Angeles—City Water & Power Comn., J. R. Vroman, Secy., is in the market for a 300 ton horizontal hydraulic press, Spec. W. 723.

Calif., Modesto—City, H. E. Gragg, Clk, plans to purchase three G. E. 20 kw. 6.6 ampere 2,300 v., 60 cycle automatic station type, R. F. constant current transformers and three G. E. 3 kw., 6.6. ampere, 2,300 v., 60 cycle subway type SL. constant current transformers.

Calif., Redding—City, L. Engram, Clk, plans to purchase one 7½ kw. 2,300 v. primary, 6.6 ampere, pole type moving coil regulator complete with hanger irons and oil.

Calif., San Francisco—U. S. Engineer Office, 85 Second St., will receive bids until Feb. 3 for a 20 in. booster pump.

Conn., Hartford—Arrow Electric Co., 103 Hawthorne St., is receiving bids for the installation of panel board and cable to transfer power throughout building, also 300 kva. synchronous motor. Mylschreest & Raynolds, 238 Palm St., are engineers.

Fla., Jacksonville—City Commission, F. H. Owens, Chn., will receive bids until Feb. 7 for three 1,500 hp. boilers and superheaters with soot blowers, coal and oil burners with double fronts, three air preheaters with forced and induced draft fans and connections, coal pulverizing and feeding equipment, 25,000 kw. turbo-generator and exciter, surface condensing equipment, deaerating feed water heater and storage tank, turbine-driven centrifugal boiler feed pump, etc. for Talleyrand Ave. electric light plant. Scofield Engineering Co., Commercial Trust Bldg., Philadelphia, Pa., are consulting engineers.

Ind., Richmond—City plans the installation of a new turbine in electric light plant. Estimated cost $166,400.

La., Carville—Supervising Architect, Washington, D. C., will receive bids until Feb. 17 for a boiler for Lepers Hospital here.

Mass., Haverhill—Twentieth Century Bakery Co. Inc., 32 Fleet St., is in the market for motors to operate baking machinery for proposed bakery on Fleet St. Estimated cost $40,000.

Mich., Jackson—L. W. Lamb, 501 West Michigan Ave., wants prices and catalogs on light weight caterpillar gas crane, ½ yd. clam.

Mich., Pontiac—L. M. Wrenn, c/o Oakland County Drain Commission, wants prices and catalogs on sewage pumps, etc.

Minn., Duluth—G. Patterson, 1530 London Rd., is in the market for piston rings for high pressure cylinders using steam pressure, 220 to 250 lbs., also open feed water heater.

O., Chagrin Falls—Bd. of Education, H. B. Pugsley, Clk., will receive bids until Feb. 7 for new boilers and stokers for central heating plant.

Pa., Pittsburgh—American Coat & Apron Supply Co., 1001 Chateau St., N. S., is in the market for one 20 hp., d.c. 115 v. motor, speed 1,000.

Tex., San Antonio—Woodlawn Terrace Hotel Co., c/o P. M. Chamberlain, Agt., Builders Exchange Bldg., will receive sub-bids until about Jan. 25 for heating plant, refrigeration, 4 elevators, etc. for 7 story hotel at Woodlawn Terrace. Estimated cost $1,300,000.

Wis., Burlington—J. Bazal, 558 Conkey St., is in the market for ice machine for proposed 2 story addition to creamery. Estimated cost $40,000.

Mexico, Coahuila—Palao—National Lines of Mexico Coal Mines, E. Gonzales Salas, Mgr., Mexico City, is in the market for equipment for power plant here. Estimated cost $500,000.

N. Z., Grisborne—Poverty Electric Power Bd., will receive bids until Mar. 4 for switch board equipment and four 500 kva. transformers.

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